Q-10 2.2.3 v

GROUND WATER SAMPLING PLAN

FOR

PASCO SANITARY LANDFILL

DECEMBER 1986

PREPARED BY:

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INTRODUCTION

This groundwater sampling plan is submitted pursuant to Department of Ecology Order No. DE86E112 and an October 20, 1986 letter from the Benton Franklin County Health Department relative to Pasco Sanitary Landfill's solid waste permit. This plan incorporates requirements of both agencies. The Department of Ecology order is included as Appendix 1 and the letter is included as Appendix 2. Actual data already collected at this site is used as a basis for this plan. The plan is being requested four years after data was initially collected.

1. WELL LOCATION AND CONSTRUCTION

The locations of the wells mentioned in the DOE order are shown on Figure 1. There are now 15 wells at the site. The original 5 were installed by J-U-B ENGINEERS, Inc. in 1982. The most recent wells were installed by Ecology and Environment under contract to EPA. Typical construction diagrams for the wells are shown in Figures 2 and 3.

2. METHODS OF SAMPLE COLLECTION

Prior to collection of each sample, groundwater elevation will be measured and each well will be purged of 3 to 5 volumes of water. The data sheet for well elevation measurements is provided in Figure 4. One volume of water is equal to the amount of water standing in the well casing at the time purging begins. Samples will be collected by utilizing 2 inch O.D. stainless steel/teflon bladder pumps. Dedicated stainless steel/teflon bladder pumps will be installed at well locations EE2, EE3, and J-U-B2. These dedicated pumps will not be taken out of the wells but will remain in each well over the sampling life of the well. A portable bladder pump will be used to pump all other wells. Information of bladder pumps is provided as Appendix 3.

3. DECONTAMINATION

The portable bladder pump will be rinsed with a high pressure rinse water externally prior to going from one well to another. In addition, an acetone and distilled water rinse will be used to flush the internal surfaces of the pump and sample tubing.

4. SAMPLE HANDLING

Table 1 provides a list of parameters that are required by this plan. The table includes a listing of the persons or laboratories responsible for each analysis, the bottles that will be needed, the volume of sample to be collected, and the preservation of the sample. Laboratories will be instructed concerning which parameters to be analyzed by the use of the form as illustrated in Figure 5. Samples will be shipped by bus or air freight to the appropriate laboratory.

5. QUALITY CONTROL/QUALITY ASSURANCE

Quality control involves the inspection analysis and action applied to a portion of this job to estimate quality of the product and determine what, if any, changes must be made to achieve or maintain the required level of quality. Quality assurance relates to the review inspection of all or a portion of the final product to insure that the desired quality is obtained. Quality control on the groundwater sampling effort will involve as a minimum the collection and analysis of at least one duplicate sample every other round of sampling and one field spike sample every round of sampling. Spiked parameters will include at least one parameter from each category for analysis in Table 1. Quality control relative to the analysis of the groundwater samples will be similar to the quality control plan established by Ecology and Environment when they conducted work at the Pasco Sanitary Landfill. The following discussion has been taken from the Ecology and Environment sampling plan for Resource Recovery Corporation, Pasco, Washington, TDDR10-8410-14.

Those items added to the original Ecology and Environmental submittal are underlined. Quality control for this sampling effort may involve any or all of the following elements.

a. Field Blank

Field blanks are prepared in the field prior to shipment to the laboratory. They are stored along side the collected samples and shipped back to the laboratory for analysis. Field blanks are analyzed with the field samples and they indicate whether the sample bottles were exposed to contaminants during handling and transit or if samples were cross-contaminated. Where possible, the laboratory should not be told which sample is the field blank.

b. Method Blank/Reagent Blank

A laboratory pure water blank is analyzed along with all water samples submitted for analyses. The method blank is processed through all procedures, materials, and labware used or sample preparation.

c. Calibration Standards

A calibration standard is prepared in the laboratory by dissolving a known amount of a pure compound in an appropriate matrix. The final concentration calculated from the known quantities is the true value of the standard. The results obtained from these standards are used to generate a standard curve and thereby quantitate the compound in the environmental sample.

d. Check Standard

A check standard is prepared in the same manner as a calibration standard. The final concentration calculated from the known quantities is the true value of the standard. The important difference in a check standard is that it is not carried through the same process used for the environmental samples, but is injected directly onto the gas chromatographic column. A check standard result is used to validate an existing concentration calibration standard file or calibration curve.

The check standard can provide information on the accuracy of the total analytical method independent of various sample matrices. Specific requirements and procedures for calibration and check standards are outlined in the EPA Contract Laboratory Program.

e. Control

A control is a sample of know value used to validate the analytical procedure.

f. Spike

A sample spike is prepared by adding a known amount of a pure compound to the environmental sample (before extraction for extractables), and the compound is the same as that being assayed for in the environmental sample. These spikes simulate the background and interferences found in the actual samples and the calculated percent recovery of the spike is taken as measure of the accuracy of the total analytical method. When there is no change in volume due to the spike, it is calculated as follows:

$$P = \frac{100(O-X)}{T}$$

P = percent recovery
O = Measured value of analyte
T = Measured value of analyte concentration in the sample before the spike is added.

Tolerance limits for acceptable percent recovery are established in the EPA Contract Laboratory Program.

g. Internal Standard

Prepared by adding a known amount of pure compound to the environmental sample, and the compound selected is not one expected to be found in the sample, but is similar in nature to the compound of interest. Internal standards are added to the environmental sample just prior to analysis. (NOTE: Internal standards and surrogate spikes are different compounds. The internal standard is for quantification purposes using the relative response factor, while surrogate spikes indicate the percent recovery and therefore the efficiency of the methodology).

h. Matrix Spike/Duplicate

Aliquots are made in the laboratory of the same sample and each aliquot is treated exactly the same throughout the analytical method. Spikes are added at approximately ten times the method detection limit (see Form V for the spike compounds used). The percent difference between the value of the duplicates, as calculated below, is taken as a measure of the precision of the analytical method.

$$PD = \frac{2(D_1 - D_2)100}{(D_1 + D_2)}$$

PD = percent difference
D_1 = first sample value
D_2 = second sample value (duplicated)

The tolerance limit for percent differences between laboratory duplicators should not exceed 15 percent for validation.

i. Field Spike

Field spikes are prepared in the field prior to shipment to the laboratory. They are prepared using a duplicate sample and spiking with one or more of the parameters of interest. They are stored along side the collected samples and shipped back to the laboratory for analysis. Field spikes are analyzed with the field samples and they indicate whether the sample bottles were exposed to contaminants during handling and transit or if samples were cross-contaminated. Field spikes are an independent check upon the laboratory since the laboratory is not told of the spiking procedures and has no involvement in the spiking process.

The laboratories will report their own quality control data. A lab blank and a lab matrix spike will be analyzed with each batch of organic samples. A laboratory control value will be reported with each batch of analyses. Examples of quality control data sheets are provided in Appendix 4. An example of field blank quality control data is provided in Appendix 5.

6. ANALYTICAL TECHNIQUES

Analytical techniques are provided in Appendix 6.

7. STATISTICAL EVALUATION OF ANALYTICAL DATA

The meaning of the results of this statistical evaluation is provided in the following material.

The information generated relative to the upgradient control well and the downgradient well #J-U-B 4 will be used to explain the results, see Table 2. There are five categories to Table 2. This table provides all the information gathered to date on the Pasco Landfill. The relative rows and columns have the same meaning. Row 4 in the table lists the parameters which were tested and the information collected on the sampling dates is provided between rows 6 and 15. The mean concentration of each of the parameters is provided in row 22. The acceptable level (row 23) is the level set as the drinking water standard. Compliance (row 24) means true, the mean is less than the standard or false, the mean is more than the standard. For well J-U-B 4, similar information is provided in rows 28 to 47.

Statistical information relative to the two means for each parameter is provided in rows 48 through 57. This information relates directly to the students t-test. Since a parameter such as pH could be less or greater than the concentration observed in the upgradient well, a positive t value and a negative t value are provided in rows 54 and 56. Calculated t's are provided in row 53. The probability value selected for the associated t values is .01. A .01 level of probability is called highly significant. The judgement of a significant difference between the two means is provided in rows 55 and 57. The word "false" in cell B48 indicates that the probability of there being no significant difference between the mean of the upgradient well and the mean of the pH at the downgradient well is greater than 1 percent. Such a difference as was observed would therefore be likely to occur by chance more than 1 in 100 times. A true statement in either rows 55 or 57 would lead us to the conclusion that a significance difference is proven at this level of probablility.

It should be noted that the values entered for the detection limit concentration were entered at one half of the actual detection limit since it is assumed that there is something less than the detection value present in the groundwater. In the tables provided, some of the numbers have been italicized. The italicized numbers are actually one half of the detection limit encountered wherever these italicized numbers occur. This was done according to the Environmental Protection Agency's RCRA Groundwater Monitoring Technical Enforcement Guidance Document, September 1986, pages 122 and 123. The use of t test is explained by Rovers & McBean, Significance Testing for Impact Evaluations, "Groundwater Monitoring Review", Volume 1, #2, 1981, pp. 39-43.

TABLES

TABLE 1 SAMPLING HANDLING REQUIREMENTS

						Preservation		
Primary Chemical and Physical Contaminants	**Analytical Responsibility**	**No.**	**Container**	**(QTY)**	**Sample Volume**	**None**	**MTL.**	**Cooled**
Arsenic	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Barium	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Cadmium	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Chrome	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Fluoride	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Lead	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Mercury	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Nitrate (as N)	Laucks/Alchem	2	Plastic	(1)	500 ml		H2SO4	
Selenium	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Sodium Silver	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Turbidity	Laucks/Alchem	3	Plastic		500 ml	x		X
Primary Drinking Water Pesticides								
Endrin	Laucks	4	Glass	(2)	1000 ml	x		x
Lindane	Laucks	4	Glass	(2)	1000 ml	x		x
Methoxychlor	Laucks	4	Glass	(2)	1000 ml	x		x
Toxaphene	Laucks	4	Glass	(2)	1000 ml	x		x
2,4-D	Laucks	4	Glass	(2)	1000 ml	x		x
2,4,5-TP Silvex	Laucks	4	Glass	(2)	1000 ml	x		x
Secondary Chemical and Physical Contaminants								
Chloride	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Color	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Copper	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Iron	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Manganese	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Specific Conductivity	J-U-B	5	Polyethylene	(1)	500 ml	x		
Sulfate	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Total Dissolved Solids	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Zinc	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	

Primary Chemical and Physical Contaminants	Analytical Responsibility	No.	Container	(QTY)	Sample Volume	Preservation None	Preservation MTL.	Preservation Cooled
Minimum Functional Standard Contaminants								
Temperature	J-U-B	5	Polyethylene	(1)	500 ml	x		
Conductivity	J-U-B	5	Polyethylene	(1)	500 ml	x		
pH	J-U-B	5	Polyethylene	(1)	500 ml	x		
Chloride	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Nitrate, Nitrite, and Ammonia as Nitrogen	Laucks/Alchem	2	Plastic	(1)	500 ml		H2SO4	
Sulfate	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Dissolved Iron	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Dissolved Zinc and Manganese	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Chemical Oxygen Demand	Laucks/Alchem	2	Plastic	(1)	500 ml		H2SO4	
Total Organic Carbon	Laucks	6	Glass	(2)	250 ml		H3PO4	x
Total Coliform	BFCHD	7	Polyethlene	(1)	125 ml	x		x
Organic Solvents								
1,1-Dichloroethylene	Laucks	8	Glass	(2)	250 ml	x		x
1,1-Dichloroethane	Laucks	8	Glass	(2)	250 ml	x		x
Trichloroethylene	Laucks	8	Glass	(2)	250 ml	x		x
Chloroform	Laucks	8	Glass	(2)	250 ml	x		x
1,1,1-Trichloroethane	Laucks	8	Glass	(2)	250 ml	x		x
Trichloroethylene	Laucks	8	Glass	(2)	250 ml	x		x
Tetrachloroethylene	Laucks	8	Glass	(2)	250 ml	x		x
Toluene	Laucks	8	Glass	(2)	250 ml	x		x
Total Xylene	Laucks	8	Glass	(2)	250 ml	x		x

	A	B	C	D	E	F	G	H	I	J	K	L
1			TABLE 2	PRIMARY DRINKING WATER CHEMICAL AND PHYSICAL PARAMETERS (mg/l)								
2												
3												
4	CONTROL WELL	ARSENIC	BARIUM	CADMIUM	CHROMIUM	FLUORIDE	LEAD	MERCURY	NITRATE	SELENIUM	SILVER	SODIUM
5	DATE								(AS N)			
6	Feb-82	*0.00500*	*0.05000*	*0.00050*	*0.00250*	0.37000	*0.00250*	*0.00025*	5.22000	*0.00250*	*0.00250*	
7	Apr-82								5.10000			
8	Sep-82								4.10000			
9	Dec-82								4.33000			
10	Mar-83								5.37000			35.00000
11	Jun-83											
12	Mar-84								5.53000			
13	Jul-85											
14	Jul-86											
15	Oct-86	*0.00500*	*0.05000*	*0.00050*	*0.00250*		*0.00250*	*0.00025*		*0.00250*	0.00050	34.10000
16												
17	SUM	0.01000	0.10000	0.00100	0.00500	0.37000	0.00500	0.00050	29.65000	0.00500	0.00300	69.10000
18	SUM OF SQS	0.00005	0.00500	0.00000	#VALUE!	0.13690	0.00001	0.00000	148.23510	0.00001	0.00001	2387.81000
19	# OF OBS	2.00000	2.00000	2.00000	2.00000	1.00000	2.00000	2.00000	6.00000	2.00000	2.00000	2.00000
20	VARIANCE	0.00000	0.00000	0.00000	0.00000	#DIV/0!	0.00000	0.00000	0.41152	0.00000	0.00000	0.81000
21	STD DEV	0.00000	0.00000	0.00000	0.00000	#DIV/0!	0.00000	0.00000	0.58561	0.00000	0.00141	0.63640
22	MEAN	0.00500	0.05000	0.00050	0.00250	0.37000	0.00250	0.00025	4.94167	0.00250	0.00150	34.55000
23	ACCEPTABLE LEVEL	0.05000	1.00000	0.01000	0.05000	1.80000	0.05000	0.00200	10.00000	0.01000	0.05000	NONE
24	COMPLIANCE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	N/A
25												
26				PRIMARY DRINKING WATER CHEMICAL AND PHYSICAL PARAMETERS (mg/l)								
27												
28												
29	WELL #4	ARSENIC	BARIUM	CADMIUM	CHROMIUM	FLUORIDE	LEAD	MERCURY	NITRATE	SELENIUM	SILVER	SODIUM
30	DATE								(AS N)			
31	Feb-82											
32	Apr-82											
33	Sep-82											
34	Dec-82	*0.00500*	*0.25000*	*0.00050*	*0.00250*	0.40000	*0.00250*	*0.00025*	4.45000	*0.00250*	*0.00250*	
35	Mar-83								4.63000			
36	Jun-83								5.30000			
37	Mar-84								4.99000			36.00000
38	Jul-85											
39	Jul-86											
40	Oct-86	*0.00500*	0.16000	*0.00050*	*0.00250*		*0.00250*	*0.00025*		*0.00250*	*0.00050*	37.00000
41	SUM	0.01000	0.41000	0.00100	0.00500	0.40000	0.00500	0.00050	19.37000	0.00500	0.00300	73.00000
42	SUM OF SQS	0.00005	0.08810	0.00000	0.00001	0.16000	0.00001	0.00000	94.22950	0.00001	0.00001	2665.00000
43	# OF OBS	2.00000	2.00000	2.00000	2.00000	1.00000	2.00000	2.00000	4.00000	2.00000	2.00000	2.00000
44	VARIANCE	0.00000	0.00810	0.00000	0.00000	#DIV/0!	0.00000	0.00000	0.19123	0.00000	0.00000	1.00000
45	STD DEV	0.00000	0.06364	0.00000	0.00000	#DIV/0!	0.00000	0.00000	0.37871	0.00000	0.00141	0.70711
46	MEAN	0.00500	0.20500	0.00050	0.00250	0.40000	0.00250	0.00025	4.84250	0.00250	0.00150	36.50000
47	ACCEPTABLE LEVEL	0.05000	1.00000	0.01000	0.05000	1.80000	0.05000	0.00200	10.00000	0.01000	0.05000	-
48	COMPLIANCE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
49												
50	CONTROL WELL											
51	VS WELL #4											
52	COMMVAR	0.00000	0.00405	0.00000	0.00000	#DIV/0!	0.00000	0.00000	0.32341	0.00000	0.00000	0.90500
53	STD ERROR	0.00000	0.06364	0.00000	0.00000	#DIV/0!	0.00000	0.00000	0.36709	0.00000	0.00200	0.95131
54	DF	2.00000	2.00000	2.00000	2.00000	0.00000	2.00000	2.00000	8.00000	2.00000	2.00000	2.00000
55	CALC T	#DIV/0!	-2.43559	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.27014	#DIV/0!	0.00000	-2.04979
56	ACCEPTABLE+T	6.96500	6.96500	6.96500	6.96500		6.96500	6.96500	2.86900	6.96500	6.96500	6.96500
57	SIG DIFF	#DIV/0!	FALSE	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	FALSE	#DIV/0!	FALSE	FALSE
58	ACCEPTABLE-T	-6.96500	-6.96500	-6.96500	-6.96500		-6.96500	-6.96500	-2.86900	-6.96500	-6.96500	-6.96500
59	SIG DIFF	#DIV/0!	FALSE	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	FALSE	#DIV/0!	FALSE	FALSE

	M	N	O	P	Q	R	S
1	TABLE 2 (CONT.)		PRIMARY DRINKING WATER PESTICIDES (mg/l)				
2							
3							
4	CONTROL WELL	LINDANE	ENDRIN	METHOXY-	TOXAPHENE	2, 4-D	SILVEX
5	DATE			CHLOR			
6	Feb-82	0.01000	0.02500	0.05000	1.00000	2.50000	0.25000
7	Apr-82						
8	Sep-82						
9	Dec-82						
10	Mar-83						
11	Jun-83						
12	Mar-84						
13	Jul-85	0.025	0.05000	0.25000	0.50000	0.50000	0.50000
14	Jul-86						
15	Oct-86						
16							
17	SUM	0.03500	0.07500	0.30000	1.50000	3.00000	0.75000
18	SUM OF SQS	0.00073	0.00313	0.06500	1.25000	6.50000	0.31250
19	# OF OBS	2.00000	2.00000	2.00000	2.00000	2.00000	2.00000
20	VARIANCE	0.00023	0.00063	0.04000	0.25000	4.00000	0.06250
21	STD DEV	0.01061	0.01768	0.14142	0.35355	1.41421	0.17678
22	MEAN	0.01750	0.03750	0.15000	0.75000	1.50000	0.37500
23	ACCEPTABLE LEVEL	4.00000	0.20000	100.00000	5.00000	100.00000	10.00000
24	COMPLIANCE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
25							
26			PRIMARY DRINKING WATER PESTICIDES (mg/l)				
27							
28							
29	WELL #4	LINDANE	ENDRIN	METHOXY-	TOXAPHENE	2, 4-D	SILVEX
30	DATE			CHLOR			
31	Feb-82						
32	Apr-82						
33	Sep-82						
34	Dec-82	0.01000	0.02500	0.05000	1.00000	2.50000	0.25000
35	Mar-83						
36	Jun-83						
37	Mar-84						
38	Jul-85	0.025	0.05000	0.25000	0.50000	0.50000	0.50000
39	Jul-86						
40	Oct-86						
41	SUM	0.03500	0.07500	0.30000	1.50000	3.00000	0.75000
42	SUM OF SQS	0.00073	0.00313	0.06500	1.25000	6.50000	0.31250
43	# OF OBS	2.00000	2.00000	2.00000	2.00000	2.00000	2.00000
44	VARIANCE	0.00023	0.00063	0.04000	0.25000	4.00000	0.06250
45	STD DEV	0.01061	0.01768	0.14142	0.35355	1.41421	0.17678
46	MEAN	0.01750	0.03750	0.15000	0.75000	1.50000	0.37500
47	ACCEPTABLE LEVEL	4.00000	0.20000	100.00000	5.00000	100.00000	10.00000
48	COMPLIANCE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
49							
50	CONTROL WELL						
51	VS WELL #4						
52	COMM VAR	0.00023	0.00063	0.04000	0.25000	4.00000	0.06250
53	STD ERROR	0.01500	0.02500	0.20000	0.50000	2.00000	0.25000
54	DF	2.00000	2.00000	2.00000	2.00000	2.00000	2.00000
55	CALC T	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
56	ACCEPTABLE+T	6.96500	6.96500	6.96500	6.96500	6.96500	6.96500
57	SIG DIFF	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
58	ACCEPTABLE-T	-6.96500	-6.96500	-6.96500	-6.96500	-6.96500	-6.96500
59	SIG DIFF	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE

	T	U	V	W	X	Y	Z	AA	AB	AC
1	TABLE 2 (CONT.)		SECONDARY DRINKING WATER CHEMICAL AND PHYSICAL CONTAMINANTS (mg/l)							
2										
3									TOTAL	
4	CONTROL WELL	CHLORIDE	COLOR	COPPER	IRON	MANGANESE	SPECIFIC	SULPHATE	DISSOLVED	ZINC
5	DATE						CONDUCTIVITY		SOLIDS	
6	Feb-82	26.00000	*2.50000*	*0.00500*	0.49000	0.04000		83.00000	394.00000	*0.02500*
7	Apr-82					0.02000	570.00000		416.00000	
8	Sep-82				0.40000	0.01000	610.00000		416.00000	
9	Dec-82				2.10000	0.11000	555.00000		454.00000	
10	Mar-83	26.00000			0.39000	0.01000	620.00000		412.00000	
11	Jun-83									
12	Mar-84	26.30000			0.30000	0.02000	600.00000	32.00000	428.00000	
13	Jul-85									
14	Jul-86									
15	Oct-86			*0.00500*	0.52000	0.01000				*0.00250*
16										
17	SUM	78.30000	2.50000	0.01000	4.20000	0.22000	2955.00000	115.00000	2520.00000	0.02750
18	SUM OF SQS	2043.69000	6.25000	0.00005	5.32260	0.01480	1749425.00000	7913.00000	1060392.00000	0.00063
19	# OF OBS	3.00000	1.00000	2.00000	6.00000	7.00000	5.00000	2.00000	6.00000	2.00000
20	VARIANCE	0.04500	#DIV/0!	0.00000	0.57182	0.00153	943.75000	2601.00000	478.08000	0.00051
21	STD DEV	0.17321	#DIV/0!	0.00000	0.69030	0.03625	27.47726	36.06245	19.95996	0.01591
22	**MEAN**	**26.10000**	**2.50000**	**0.00500**	**0.70000**	**0.03143**	**591.00000**	**57.50000**	**420.00000**	**0.01375**
23	**ACCEPTABLE LEVEL**	**250.00000**	**15.00000**	**1.00000**	**0.30000**	**0.05000**	**700.00000**	**250.00000**	**500.00000**	**5.00000**
24	**COMPLIANCE**	**TRUE**	**TRUE**	**TRUE**	**FALSE**	**TRUE**	**TRUE**	**TRUE**	**TRUE**	**TRUE**
25										
26			SECONDARY DRINKING WATER CHEMICAL AND PHYSICAL CONTAMINANTS (mg/l)							
27										
28									TOTAL	
29	WELL #4	CHLORIDE	COLOR	COPPER	IRON	MANGANESE	SPECIFIC	SULPHATE	DISSOLVED	ZINC
30	DATE						CONDUCTIVITY		SOLIDS	
31	Feb-82									
32	Apr-82									
33	Sep-82									
34	Dec-82	28.00000	*2.50000*	*0.00500*	0.70000	0.02000	555.00000		478.00000	*0.02500*
35	Mar-83	23.00000			0.66000	0.02000	380.00000		560.00000	
36	Jun-83				*0.02500*	*0.00500*	600.00000		440.00000	
37	Mar-84	25.50000			0.10000	0.01000	660.00000	34.00000	443.00000	
38	Jul-85									
39	Jul-86									
40	Oct-86			*0.00500*	0.21000	*0.00500*				0.00600
41	SUM	76.50000	2.50000	0.01000	1.69500	0.06000	2195.00000	34.00000	1921.00000	0.03100
42	SUM OF SQS	1963.25000	6.25000	0.00005	0.98033	0.00095	1248025.00000	1156.00000	931933.00000	0.00066
43	# OF OBS	3.00000	1.00000	2.00000	5.00000	5.00000	4.00000	1.00000	4.00000	2.00000
44	VARIANCE	9.37500	#DIV/0!	0.00000	0.12679	0.00007	19341.66667	#DIV/0!	4165.66667	0.00036
45	STD DEV	2.50000	#DIV/0!	0.00000	0.31848	0.00758	120.44189	#DIV/0!	55.89499	0.01344
46	**MEAN**	**25.50000**	**2.50000**	**0.00500**	**0.33900**	**0.01200**	**548.75000**	**34.00000**	**480.25000**	**0.01550**
47	**ACCEPTABLE LEVEL**	**250.00000**	**15.00000**	**1.00000**	**0.30000**	**0.05000**	**700.00000**	**250.00000**	**500.00000**	**5.00000**
48	**COMPLIANCE**	**TRUE**	**TRUE**	**TRUE**	**FALSE**	**TRUE**	**TRUE**	**TRUE**	**TRUE**	**TRUE**
49										
50	**CONTROL WELL**									
51	**VS WELL #4**									
52	COMMVAR	4.71000	#DIV/0!	0.00000	0.36953	0.00092	9120.60185	#DIV/0!	1953.11467	0.00043
53	STD ERROR	1.77200	#DIV/0!	0.00000	0.36810	0.01780	64.06458	#DIV/0!	28.52714	0.02082
54	DF	4.00000	0.00000	2.00000	9.00000	10.00000	7.00000	1.00000	8.00000	2.00000
55	**CALC T**	**0.33860**	**#DIV/0!**	**#DIV/0!**	**0.98072**	**1.09133**	**0.65949**	**#DIV/0!**	**-2.11202**	**-0.08404**
56	**ACCEPTABLE+T**	**3.74700**		**6.96500**	**2.82100**	**2.76400**	**2.99800**		**2.89600**	**6.96500**
57	**SIG DIFF**	**FALSE**	**#DIV/0!**	**#DIV/0!**	**FALSE**	**FALSE**	**FALSE**	**#DIV/0!**	**FALSE**	**FALSE**
58	**ACCEPTABLE-T**	**-3.74700**		**-6.96500**	**-2.82100**	**-2.76400**	**-2.99800**		**-2.89600**	**-6.96500**
59	**SIG DIFF**	**FALSE**	**#DIV/0!**	**#DIV/0!**	**FALSE**	**FALSE**	**FALSE**	**#DIV/0!**	**FALSE**	**FALSE**

	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR
1			TABLE 2 (CONT.		MINIMAL	FUNCTIONAL STANDARDS PARAMETERS (mg/l)									
2															
3													CHEMICAL	TOTAL	
4	CONTROL WELL	TEMP	SPECIFIC	pH	CHLORIDE	NO2-N	NO3-N	NH3-N	SULPHATE	DISSOLVED	DISSOLVED	DISSOLVED	OXYGEN	ORGANIC	TOTAL
5	DATE		CONDUCTIVITY							IRON	ZINC	MANGANES	DEMAND	CARBON	COLIFORM
6	Feb-82			7.80000	26.00000		5.22000		83.00000	0.49000	0.02500	0.04000			1.00000
7	Apr-82		570.00000	7.35000			5.10000					0.02000			
8	Sep-82		610.00000	7.90000			4.10000			0.40000		0.01000			
9	Dec-82		555.00000	7.30000			4.33000			2.10000		0.11000			
10	Mar-83		620.00000	7.70000	26.00000		5.37000			0.39000		0.01000			
11	Jun-83														
12	Mar-84		600.00000		26.30000		5.53000		32.00000	0.30000		0.02000		2.40000	
13	Jul-85														
14	Jul-86														
15	Oct-86									0.52000	0.00250	0.01000			
16															
17	SUM	0.00000	2955.00000	38.05000	78.30000	0.00000	29.65000	0.00000	115.00000	4.20000	0.02750	0.22000	0.00000	2.40000	1.00000
18	SUM OF SQS	0.00000	1749425.00000	289.85250	2043.69000	0.00000	148.23510	0.00000	7913.00000	5.32260	0.00063	0.01480	0.00000	5.76000	1.00000
19	# OF OBS	0.00000	5.00000	5.00000	3.00000	0.00000	6.00000	0.00000	2.00000	6.00000	2.00000	7.00000	0.00000	1.00000	1.00000
20	VARIANCE	#DIV/0!	943.75000	0.09125	0.04500	#DIV/0!	0.41152	#DIV/0!	2601.00000	0.57182	0.00051	0.00153	#DIV/0!	#DIV/0!	#DIV/0!
21	STD DEV	#DIV/0!	27.47726	0.27019	0.17321	#DIV/0!	0.58561	#DIV/0!	36.06245	0.69030	0.01591	0.03625	#DIV/0!	#DIV/0!	#DIV/0!
22	MEAN	#DIV/0!	591.00000	7.61000	26.10000	#DIV/0!	4.94167	#DIV/0!	57.50000	0.70000	0.01375	0.03143	#DIV/0!	2.40000	1.00000
23	ACCEPTABLE LEVEL			6.5-8.5	250.00000			10.00000	250.00000	0.30000	5.00000	0.05000			3.00000
24	COMPLIANCE	#DIV/0!	FALSE	TRUE	TRUE	#DIV/0!	FALSE	#DIV/0!	TRUE	FALSE	TRUE	TRUE			TRUE
25															
26					MINIMAL	FUNCTIONAL STANDARDS PARAMETERS (mg/l)									
27															
28													CHEMICAL	TOTAL	
29	WELL #4	TEMP	SPECIFIC	pH	CHLORIDE	NO2-N	NO3-N	NH3-N	SULPHATE	DISSOLVED	DISSOLVED	DISSOLVED	OXYGEN	ORGANIC	TOTAL
30	DATE		CONDUCTIVITY							IRON	ZINC	MANGANES	DEMAND	CARBON	COLIFORM
31	Feb-82														
32	Apr-82														
33	Sep-82														
34	Dec-82		555.00000	7.80000	28.00000		4.45000			0.70000	0.02500	0.02000			
35	Mar-83		380.00000	7.20000	23.00000		4.63000			0.66000		0.02000			
36	Jun-83		600.00000	7.80000			5.30000			0.00250		0.00500			
37	Mar-84		660.00000		25.50000		4.99000		34.00000	0.10000		0.01000		2.40000	
38	Jul-85														
39	Jul-86														
40	Oct-86									0.21000	0.00600	0.00500			
41	SUM	0.00000	2195.00000	22.80000	76.50000	0.00000	19.37000	0.00000	34.00000	1.67250	0.03100	0.06000	0.00000	2.40000	0.00000
42	SUM OF SQS	0.00000	1248025.00000	173.52000	1963.25000	0.00000	94.22950	0.00000	1156.00000	0.97971	0.00066	0.00095	0.00000	5.76000	0.00000
43	# OF OBS	0.00000	4.00000	3.00000	3.00000	0.00000	4.00000	0.00000	1.00000	5.00000	2.00000	5.00000	0.00000	1.00000	0.00000
44	VARIANCE	#DIV/0!	19341.66667	0.18000	9.37500	#DIV/0!	0.19123	#DIV/0!	#DIV/0!	0.13133	0.00036	0.00007	#DIV/0!	#DIV/0!	#DIV/0!
45	STD DEV	#DIV/0!	120.44189	0.34641	2.50000	#DIV/0!	0.37871	#DIV/0!	#DIV/0!	0.32414	0.01344	0.00758	#DIV/0!	#DIV/0!	#DIV/0!
46	MEAN	#DIV/0!	548.75000	7.60000	25.50000	#DIV/0!	4.84250	#DIV/0!	34.00000	0.33450	0.01550	0.01200	#DIV/0!	2.40000	#DIV/0!
47	ACCEPTABLE LEVEL			6.5-8.5	250.00000			10.00000	250.00000	0.30000	5.00000	0.05000			3.00000
48	COMPLIANCE	#DIV/0!	FALSE	TRUE	TRUE	#DIV/0!	FALSE	#DIV/0!	TRUE	FALSE	TRUE	TRUE	#DIV/0!	FALSE	#DIV/0!
49															
50	CONTROL WELL														
51	VS WELL #4														
52	COMM VAR	#DIV/0!	9120.60185	0.12453	4.71000	#DIV/0!	0.32341	#DIV/0!	#DIV/0!	0.37160	0.00043	0.00092	#DIV/0!	#DIV/0!	#DIV/0!
53	STD ERROR	#DIV/0!	64.06458	0.25771	1.77200	#DIV/0!	0.36709	#DIV/0!	#DIV/0!	0.36912	0.02082	0.01780	#DIV/0!	#DIV/0!	#DIV/0!
54	DF	-2.00000	7.00000	6.00000	4.00000	-2.00000	8.00000	-2.00000	1.00000	9.00000	2.00000	10.00000	-2.00000	0.00000	-1.00000
55	CALC T	#DIV/0!	0.65949	0.03880	0.33860	#DIV/0!	0.27014	#DIV/0!	#DIV/0!	0.99018	-0.08404	1.09133	#DIV/0!	#DIV/0!	#DIV/0!
56	ACCEPTABLE+T		2.99800	3.14300	3.74700		2.89600			2.82100	6.96500	2.76400			
57	SIG DIFF	#DIV/0!	FALSE	FALSE	FALSE	#DIV/0!	FALSE	#DIV/0!	#DIV/0!	FALSE	FALSE	FALSE	#DIV/0!	#DIV/0!	#DIV/0!
58	ACCEPTABLE-T		-2.99800	-3.14300	-3.74700		-2.89600			-2.82100	-6.96500	-2.76400			
59	SIG DIFF	#DIV/0!	FALSE	FALSE	FALSE	#DIV/0!	FALSE	#DIV/0!	#DIV/0!	FALSE	FALSE	FALSE	#DIV/0!	#DIV/0!	#DIV/0!

	AS	AT	AU	AY	AW	AX	AY	AZ	BA	BB	BC
1				TABLE 2 (CONT.)		ORGANIC SOLVENTS (mg/l)					
2											
3									TETRACH-		
4	CONTROL WELL	1-DICHLORO	1-DICHLORO	TRANS-1	DICHLORO	CHLORO-	1-TRICHLOR	TRICHOLOR	CHLOROE	TOLUENE	TOTAL
5	DATE	ETHYLENE	ETHANE		ETHYLENE	FORM	OETHANE	OETHYLENE	THYLENE		XYLENE
6	Feb-82										
7	Apr-82										
8	Sep-82										
9	Dec-82										
10	Mar-83										
11	Jun-83										
12	Mar-84										
13	Jul-85										
14	Jul-86										
15	Oct-86	*0.50000*	*0.50000*	*0.50000*	*0.50000*	*0.50000*	*0.50000*	*0.50000*	*0.50000*	*0.50000*	*0.50000*
16											
17	SUM	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000
18	SUM OF SQS	0.25000	0.25000	0.25000	0.25000	0.25000	0.25000	0.25000	0.25000	0.25000	0.25000
19	# OF OBS	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
20	VARIANCE	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
21	STD DEV	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
22	**MEAN**	**0.50000**	**0.50000**	**0.50000**	**0.50000**	**0.50000**	**0.50000**	**0.50000**	**0.50000**	**0.50000**	**0.50000**
23	**ACCEPTABLE LEVEL**	**0.40000**	**NONE**	**0.27000**	**0.27000**	**0.10000**	**1.00000**	**0.00450**	**0.00350**	**NONE**	**0.62000**
24	**COMPLIANCE**	**FALSE**	**N/A**	**FALSE**	**FALSE**	**FALSE**	**TRUE**	**FALSE**	**FALSE**	**N/A**	**TRUE**
25											
26						ORGANIC SOLVENTS (mg/l)					
27											
28									TETRACH-		
29	WELL #4	1-DICHLORO	1-DICHLORO	TRANS-1	DICHLORO	CHLORO-	1-TRICHLOR	TRICHOLOR	CHLOROE	TOLUENE	TOTAL
30	DATE	ETHYLENE	ETHANE		ETHYLENE	FORM	OETHANE	OETHYLENE	THYLENE		XYLENE
31	Feb-82										
32	Apr-82										
33	Sep-82										
34	Dec-82										
35	Mar-83										
36	Jun-83										
37	Mar-84										
38	Jul-85										
39	Jul-86										
40	Oct-86	9.00000	40.00000	20.00000	20.00000	18.00000	150.00000	150.00000	7.00000	*0.50000*	*0.50000*
41	SUM	9.00000	40.00000	20.00000	20.00000	18.00000	150.00000	150.00000	7.00000	0.50000	0.50000
42	SUM OF SQS	81.00000	1600.00000	400.00000	400.00000	324.00000	22500.00000	22500.00000	49.00000	0.25000	0.25000
43	# OF OBS	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
44	VARIANCE	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
45	STD DEV	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
46	**MEAN**	**9.00000**	**40.00000**	**20.00000**	**20.00000**	**18.00000**	**150.00000**	**150.00000**	**7.00000**	**0.50000**	**0.50000**
47	**ACCEPTABLE LEVEL**	**0.40000**	**NONE**	**0.27000**	**0.27000**	**0.10000**	**1.00000**	**0.00450**	**0.00350**	**NONE**	**0.62000**
48	**COMPLIANCE**	**FALSE**	**N/A**	**FALSE**	**FALSE**	**FALSE**	**FALSE**	**FALSE**	**FALSE**	**N/A**	**TRUE**
49											
50	**CONTROL WELL**										
51	**VS WELL #4**										
52	COMM VAR	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
53	STD ERROR	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
54	DF	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
55	**CALC T**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
56	**ACCEPTABLE+T**										
57	**SIG DIFF**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
58	**ACCEPTABLE-T**										
59	**SIG DIFF**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

	BD	BE	BF	BG
1	TABLE 2 (CONT.)	MISCELLANEOUS PARAMETERS (mg/l)		
2				
3				
4	CONTROL WELL	PHENOL	TOX	ODOR
5	DATE			
6	Jan-82	*0.02500*	0.02000	*0.50000*
7	Apr-82	0.00130	0.09000	
8	Sep-82	*0.00025*	0.11000	
9	Dec-82	*0.00050*	0.06000	
10	Mar-83	0.00250	*0.00050*	
11	Jun-83			
12	Mar-84	0.45000	0.03000	
13	Jul-85			
14	Jul-86			
15	Oct-86			
16				
17	SUM	0.47955	0.31050	0.50000
18	SUM OF SQS	0.20313	0.02510	0.25000
19	# OF OBS	6.00000	6.00000	1.00000
20	VARIANCE	0.03955	0.00217	#DIV/0!
21	STD DEV	0.18155	0.04250	#DIV/0!
22	MEAN	0.07993	0.05175	0.50000
23	ACCEPTABLE LEVEL			3.00000
24	COMPLIANCE	FALSE	FALSE	TRUE
25				
26				
27	MISCELLANEOUS PARAMETERS (mg/l)			
28				
29	WELL #4	PHENOL	TOX	ODOR
30	DATE			
31	Feb-82			
32	Apr-82			
33	Sep-82			
34	Dec-82	*0.00050*	0.05000	
35	Mar-83	0.00400	0.07000	
36	Jun-83		0.01200	
37	Mar-84	*0.00500*	0.03000	
38	Jul-85			
39	Jul-86			
40	Oct-86			
41	SUM	0.00950	0.16200	0.00000
42	SUM OF SQS	0.00004	0.00844	0.00000
43	# OF OBS	3.00000	4.00000	0.00000
44	VARIANCE	0.00001	0.00084	#DIV/0!
45	STD DEV	0.00236	0.02505	#DIV/0!
46	MEAN	0.00317	0.04050	#DIV/0!
47	ACCEPTABLE LEVEL			3.00000
48	COMPLIANCE	FALSE	FALSE	#DIV/0!
49				
50	CONTROL WELL			
51	VS WELL #4			
52	COMM VAR	0.02637	0.00164	#DIV/0!
53	STD ERROR	0.11483	0.02610	#DIV/0!
54	DF	7.00000	8.00000	-1.00000
55	CALC T	0.66845	0.43098	#DIV/0!
56	ACCEPTABLE+T	2.99800	2.89600	
57	SIG DIFF	FALSE	FALSE	#DIV/0!
58	ACCEPTABLE-T	-2.99800	-2.89600	
59	SIG DIFF	FALSE	FALSE	#DIV/0!

FIGURES

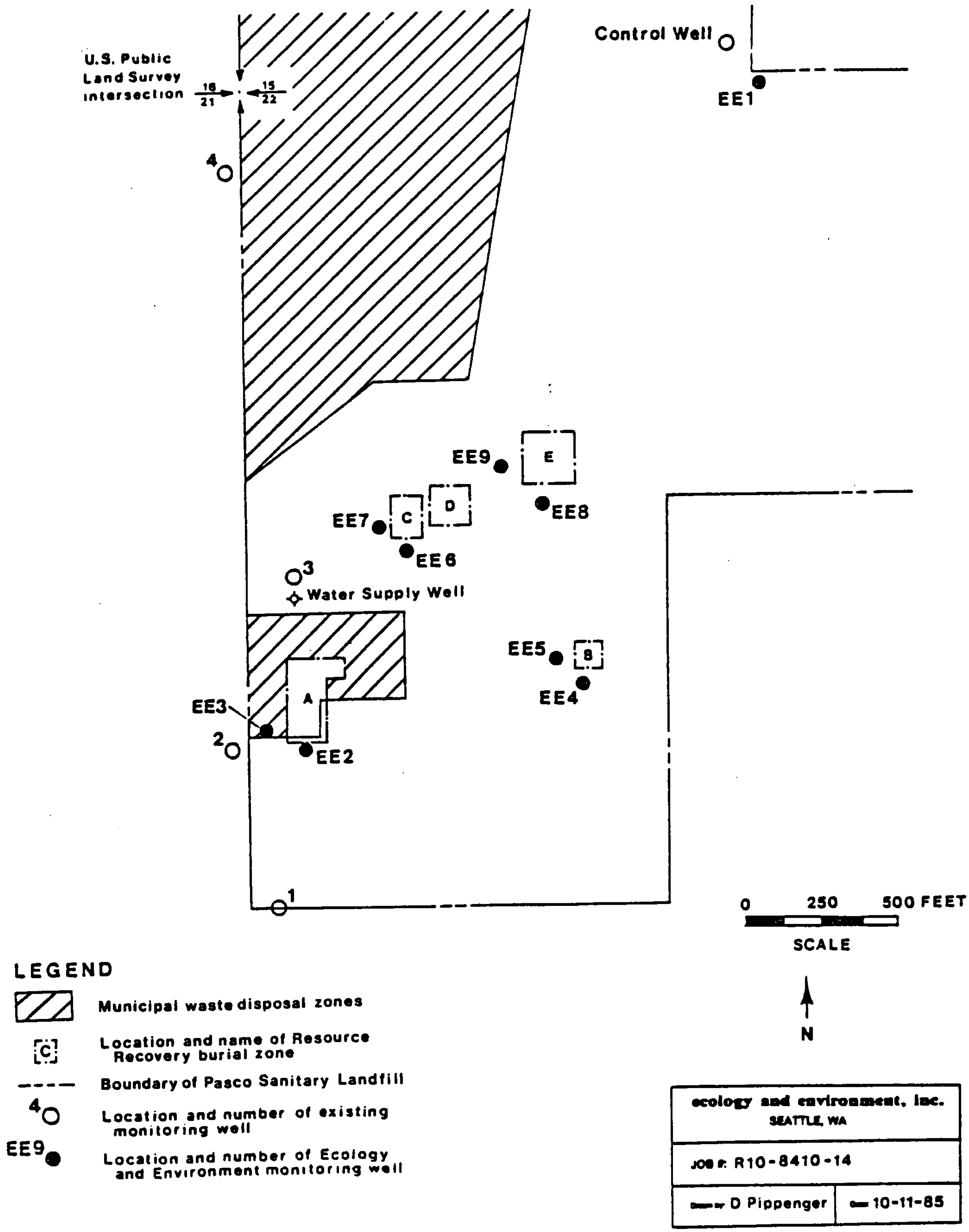


Figure 1 Monitoring well locations at Resource Recovery site, Pasco, Washington.

22.4
19.1
3.3

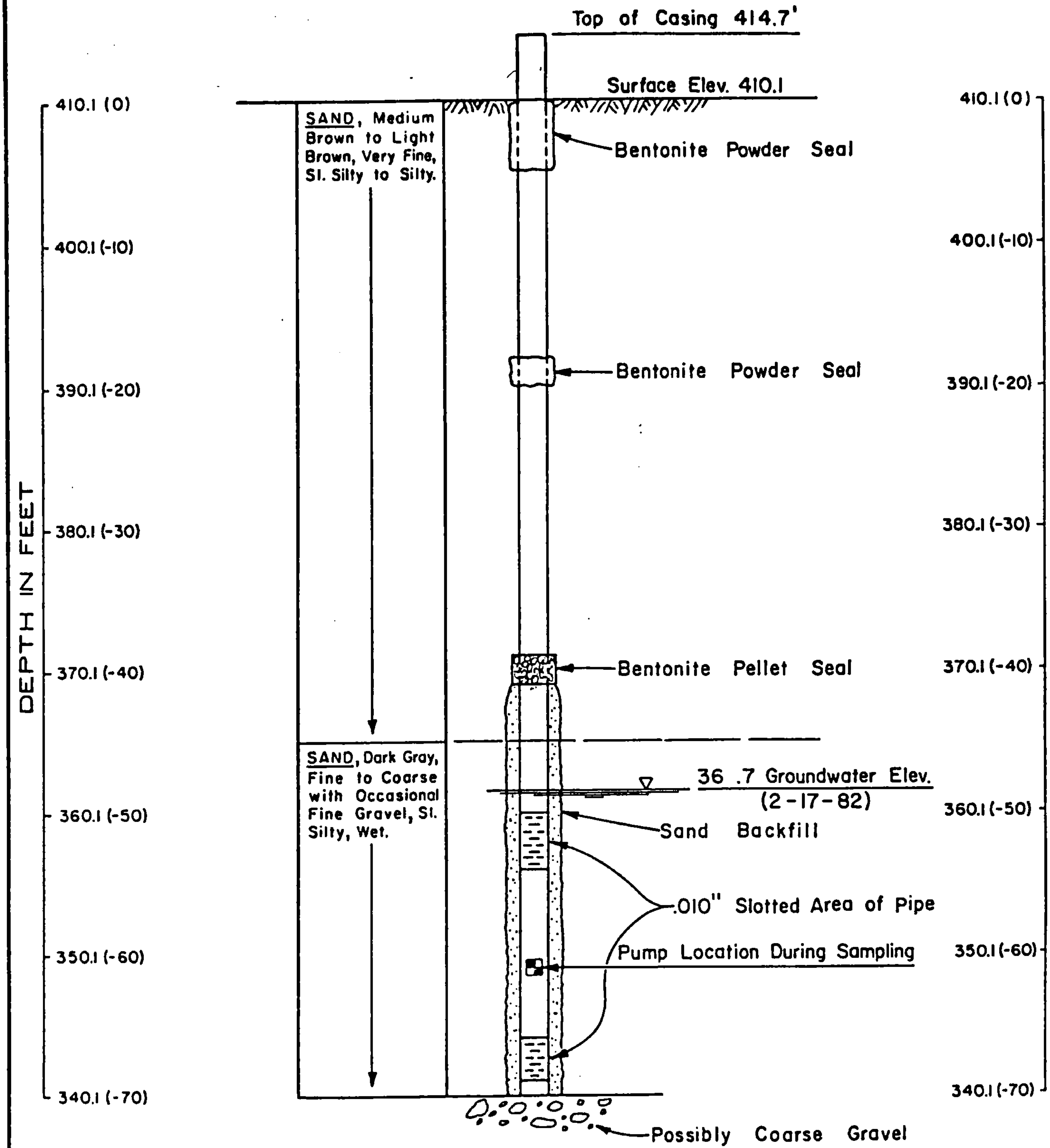


FIGURE 2

CONTROL WELL

INSTALLED 1-13-82

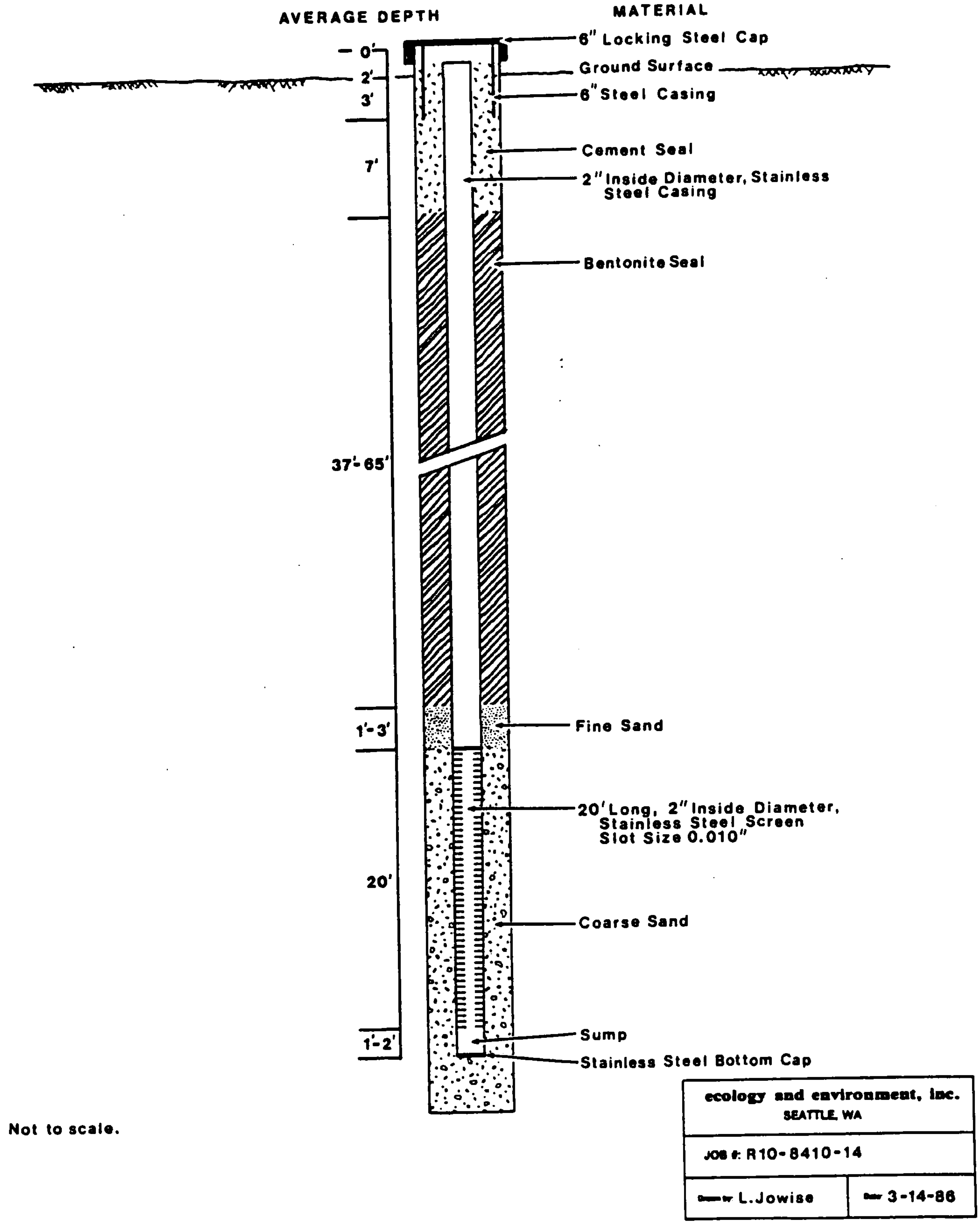


Figure 3 General well construction diagram of Ecology and Environment, Inc. monitoring wells at Resource Recovery study area, Pasco, Washington.

?When were
cuts made

? any resurveys?

GW ELEV & TEMP SHEET

	A	B	C	D	E	F	G
1					FIGURE 4		
2				GROUND WATER TEMPERATURE			
3		SITE:PASCO		AND ELEVATION DATA SHEET			
4							
5				TOP OF CASING	DEPTH TO	GROUND WATER	
6		WELL NO.	DATE	ELEVATION	WATER	ELEVATION	TEMPERATURE
7		JUB CONTROL	10/22/86	414.7	55.83	358.87	15.4
8		JUB 1	10/22/86	417.1	68.92	348.18	
9		JUB 2	10/22/86	408.1	59.79	348.31	15.8
10		JUB 3	10/22/86	420.4	73.10	347.3	
11		JUB 4	10/22/86	393.7	40.75	352.95	16.6
12							
13		EE 1	10/22/86	421.1	58.01	363.09	16.3
14		EE 2	10/22/86	419.2	67.92	351.28	16.8
15		EE 3	10/22/86	417.2	66.50	350.7	
16		EE 4		396.4			
17		EE 5		407.9			
18		EE 6		427.0			
19		EE 7		425.6			
20		EE 8		428.4			
21		EE 9		424.8			

FIGURE 5
ANALYTICAL REQUIREMENTS

LAB ____________________ **BILL TO PROJECT NO.** __________
ANALYSIS FOR PARAMETERS **DATE** ____________

Primary Chemical and Physical Contaminants	Analytical Responsibility	No.	Container	(QTY)	Sample Volume	Preservation None	MTL.	Cooled
Arsenic	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Barium	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Cadmium	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Chrome	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Fluoride	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Lead	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Mercury	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Nitrate (as N)	Laucks/Alchem	2	Plastic	(1)	500 ml		H2SO4	
Selenium	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Sodium Silver	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Turbidity	Laucks/Alchem	3	Plastic		500 ml	x		X
Primary Drinking Water Pesticides								
Endrin	Laucks	4	Glass	(2)	1000 ml	x		x
Lindane	Laucks	4	Glass	(2)	1000 ml	x		x
Methoxychlor	Laucks	4	Glass	(2)	1000 ml	x		x
Toxaphene	Laucks	4	Glass	(2)	1000 ml	x		x
2,4-D	Laucks	4	Glass	(2)	1000 ml	x		x
2,4,5-TP Silvex	Laucks	4	Glass	(2)	1000 ml	x		x
Secondary Chemical and Physical Contaminants								
Chloride	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Color	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Copper	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Iron	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Manganese	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	
Specific Conductivity	J-U-B	5	Polyethylene	(1)	500 ml	x		
Sulfate	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Total Dissolved Solids	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Zinc	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	

Primary Chemical and Physical Contaminants	Analytical Responsibility	No.	Container (QTY)		Sample Volume	Preservation None	Preservation MTL.	Preservation Cooled
Minimum Functional Standard Contaminants								
Temperature	J-U-B	5	Polyethylene	(1)	500 ml	x		
Conductivity	J-U-B	5	Polyethylene	(1)	500 ml	x		
pH	J-U-B	5	Polyethylene	(1)	500 ml	x		
Chloride	Laucks/Alchem	3	Plastic	(1)	500 ml	x		x
Nitrate, Nitrite, and Ammonia as Nitrogen	Laucks/Alchem	2	Plastic	(1)	500 ml		H2SO4	
Sulfate	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Dissolved Iron	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Dissolved Zinc and Manganese	Laucks/Alchem	1	Polyethylene	(1)	500 ml	X	HNO3	X
Chemical Oxygen Demand	Laucks/Alchem	2	Plastic	(1)	500 ml		H2SO4	
Total Organic Carbon	Laucks	6	Glass	(2)	250 ml		H3PO4	x
Total Coliform	BFCHD	7	Polyethlene	(1)	125 ml	x		x
Organic Solvents								
1,1-Dichloroethylene	Laucks	8	Glass	(2)	250 ml	x		x
1,1-Dichloroethane	Laucks	8	Glass	(2)	250 ml	x		x
Trichloroethylene	Laucks	8	Glass	(2)	250 ml	x		x
Chloroform	Laucks	8	Glass	(2)	250 ml	x		x
1,1,1-Trichloroethane	Laucks	8	Glass	(2)	250 ml	x		x
Trichloroethylene	Laucks	8	Glass	(2)	250 ml	x		x
Tetrachloroethylene	Laucks	8	Glass	(2)	250 ml	x		x
Toluene	Laucks	8	Glass	(2)	250 ml	x		x
Total Xylene	Laucks	8	Glass	(2)	250 ml	x		x

APPENDIX 1

SALLY KINKER
Director

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

N. 4601 Monroe Suite 100 • Spokane Washington 99205-1295 • (509) 456-2926

J-U-B Engineers
RECEIVED
OCT 13 1986
KENNEWICK, WASH.

October 10, 1986

Mr. Larry Dietrich
Pasco Sanitary Landfill, Inc.
P. O. Box 424
Pasco, WA 99301

Dear Mr. Dietrich:

Enclosed is ORDER No. DE 86-E112. All correspondence relating to this document should be directed to Flora J. Goldstein. If you have any questions concerning the content of this document, please call (509) 456-2926.

A form entitled "Acknowledgement of Service" is also enclosed. Please sign this form and return it to this office immediately.

This ORDER is issued under the provisions of RCW 90.48.120(2). Any person feeling aggrieved by this ORDER may obtain review thereof by application, within thirty (30) days of receipt of this ORDER, to the Pollution Control Hearings Board, Mail Stop PY-21, Olympia, WA 98504-8921, with a copy to the Director, Department of Ecology, Mail Stop PV-11, Olympia, WA 98504-8711, pursuant to the provisions of Chapter 43.21B RCW and the rules and regulations adopted thereunder.

Sincerely,

Claude W. Sappington

Claude W. Sappington
Division Supervisor
Environmental Quality Division

CWS:adw

Enclosures

CERTIFIED MAIL

cc: Philip E. Miller, Ecology/Olympia

DEPARTMENT OF ECOLOGY

IN THE MATTER OF THE COMPLIANCE BY PASCO SANITARY LANDFILL, INC. with Chapter 90.48 RCW and the Rules and Regulations of the Department of Ecology	)))))	ORDER No. DE 86-E112

To: Mr. Larry Dietrich
Pasco Sanitary Landfill, Inc.
P. O. Box 424
Pasco, WA 99301

RCW 90.48.020 defines underground waters as waters of the state. RCW 90.48.080 provides that it shall be unlawful for any persons to throw, drain, run, or otherwise discharge into any of the waters of this state, or to cause, permit or suffer to be thrown, run, drain, allowed to seep, or otherwise discharge into such waters any organic or inorganic matter that shall cause or tend to cause pollution of such waters according to the determination of the Director.

The Pasco Sanitary Landfill is a solid waste disposal facility which has been in operation since 1971. Prior to 1971, the site was known as the Basin Disposal Company dump site and was owned and operated by John Dietrich as a municipal solid waste open burning dump. In 1971, a company known as Resource Recovery Corporation was formed, with the Basin Disposal Company being part owners. A portion of the landfill was leased by Resource Recovery and operated by Larry Dietrich as a regional industrial waste disposal site. Barrels of paint manufacturing wastes, herbicide manufacturing wastes, metal finishing wastes, caustics, and acids were disposed of at the site between early 1972 and December, 1974. Resource Recovery disposal activity ended in 1974. In 1981, Larry Dietrich took over as owner and operator of the sanitary landfill.

In 1985, the Environmental Protection Agency (EPA) conducted a field investigation of the Pasco Sanitary Landfill focusing on the disposal areas operated by Resource Recovery. The investigation was part of a nationwide dioxin study. Installation of nine new ground water monitoring wells, a one-time sampling of all monitoring wells and collection of soil samples were part of the study activities.

Several volatile organic compounds were detected in the ground water, including 1,1-Dichloroethylene, 1,1-Dichloroethane, Trans-1,2-Dichloroethylene, Chloroform, 1,1,1-Trichloroethane, Trichloroethylene, Tetrachloroethylene, Toluene, and Total Xylene, in violation of RCW 90.48.080. Concentrations of Trichloroethylene and 1,1,1-Trichloroethane exceeded EPA's proposed maximum contaminant levels.

In view of the foregoing and in accordance with RCW 90.48.120(2):

IT IS ORDERED THAT Pasco Sanitary Landfill, Inc. shall, upon receipt of this ORDER, take appropriate action in accordance with the following instructions:

1. Ground water monitoring wells identified in the EPA Report as EE-2, EE-3 and JUB-2 shall be sampled on a quarterly basis for the following compounds: 1,1-Dichloroethylene, 1,1-Dichloroethane, Trans-1,2-Dichloroethylene, Chloroform, 1,1,1-Trichloroethane, Trichloroethylene, Tetrachloroethylene, Toluene, Total Xylene, and primary and secondary drinking water metals.

2. Ground water monitoring wells identified in the EPA Report as EE-1, EE-4, EE-5, EE-6, EE-7, EE-8, EE-9, JUB-1, JUB-3, JUB-4, and JUB control well shall be sampled twice a year for the compounds in Item 1.

3. Ground water monitoring wells EE-2, EE-3, EE-4, and EE-5 shall be sampled twice a year for herbicides.

4. Static water levels in all the monitoring wells shall be measured and recorded on a quarterly basis.

5. Within thirty (30) days of receipt of this ORDER, submit to the Washington Department of Ecology, Eastern Regional Office (ERO), N. 4601 Monroe, Suite 100, Spokane, WA 99205-1295, for review and approval a ground water sampling plan, including methods of sample collection, sample preservation, a QA/QC plan, and identification of the laboratory that will perform the analytical requirements of Items 1 through 3.

6. Copies of sampling results shall be submitted to the department, ERO, within fifteen (15) days of being received by the owner/operator of the facility.

7. The monitoring schedule and monitoring locations will be reviewed following one year of sampling and may be adjusted at that time.

Any person who fails to comply with any provision of this ORDER shall be liable for a penalty of up to ten thousand dollars for each day of continuing compliance.

DATED at Spokane, Washington, this 10th day of October, 1986.

John L. Arnquist
Regional Manager
Eastern Regional Office
Department of Ecology
State of Washington

APPENDIX 2

BENTON-FRANKLIN
DISTRICT HEALTH DEPARTMENT
506 McKENZIE
(509) 943-2614
RICHLAND, WA 99352

Herbert L. Cahn, M.D., F.A.C.S.
District Health Officer
Harriett M. Sprouse, R.N., M.S.
Director, Personal Health Services
Stanley V. Vendetti, R.S.
Director, Environmental Health Servic
Joyce H. Tucker, Director
Administrative Services

OCT 2? 1986
KENNEWICK, WASH.

October 20, 1986

Larry Dietrich
dba Pasco Sanitary Landfill
P.O. Box 424
Pasco, WA 99301

Dear Mr. Dietrich:

Pursuant to your June 17, 1986, submittal (compliance schedule) and subsequent correspondence and meetings with Washington Department of Ecology (WDOE) and others, the following comments are noted to summarize the status of your 1986 permit as we understand it at this time. The format for these comments generally follows your June 1986 Schedule of Compliance beginning on Page 9.

We have no particular problem with Section I. Plan of Operation.

With regard to Section II. Compliance with ground water Monitoring Requirements, the following is noted: As far as the landfill operation is concerned (as distinct from the former industrial waste site) the following wells are to be sampled quarterly (beginning in the first quarter of 1987) for the parameters noted in WAC 173-304-490 (2) (c). Additional parameters are noted in parentheses.

a. Control well (up gradient)

b. Well #4 (down gradient)

c. Well #1 (down gradient, also test for Tetrachloroethylene and Trichloroethylene

d. Well #2 (down gradinet, also test for Tetrachloroethylene and Trichloroethylene

e. Well #3 (down gradient)

The sampling frequency and parameters required by WDOE Order No. DE86-E112 will be reviewed as they become available but are not a requirement of the annual landfill permit. It is understood that should results from the industrial waste site monitoring wells prove to be impacting the present landfill, the entire issue of frequency and parameters could change.

Section III. Landfill Operating and Maintenance Standards, WAC 173-304-460 (4) E. Receive disposition from Benton-Franklin Health Department on amount of daily cover required.

The amount of cover required is six inches or more of compacted cover material. The frequency of cover can be weekly, see comments below:

WAC 173-304-460 (4) (d) Daily Cover. The request to cover weekly versus daily can be approved for the reasons noted in the application. It is noted that there have been no reported adverse developments in the past three or more years and the operator has shown good faith operations. Since WAC 173-304 became effective, the health department's presence has increased, hence more monitoring is being done. Weekly cover is approved with the understanding that daily cover (or cover on demand to handle a specific situation) can be required if conditions indicate it is no longer appropriate to cover weekly. By weekly is meant every six to seven days not eight or nine or more.

Item B, WAC 173-304-460 (4), b, vi. Clarification Requested. Insure that at least two landfill personnel are on-site with one person at the active face when the site is open to the public.

This landfill has a commercial area and a "public" area. Since the intent of this item is safety, there may be more than one way to satisfy this requirement without additional personnel. Since there are regularly two or more people at the site (one at the gate and the other at the commercial area), the "public" area is not attended to except at infrequent times during the day. Two suggestions are offered. Either would be acceptable to this department.

1. Move the public area to a location where it is visible from the gate. In the event of an accident help could be summoned, etc.

2. The operator who might be at the commercial area would be assigned the additional responsibility of of checking the "public" area hourly during open hours. This should not simply be agreed to in principle but made part of the job description.

Item F. Recycling opportunities is amply covered by the Basin Disposal plan to locate a recycle center on-site.

Section IV. Compliance with Landspreading Standards. WAC 173-304-450, (5) (c). This has to do with the way Pasco Sanitary Landfill handles liquid sludges. As proposed, this submittal cannot be approved for the following reasons.

1. WAC 173-304-450 (5) (c) assumes there is a cover crop involved. The calculations may have been done using a crop, but there is no crop that will utilize the sludge in reality. This is disposal, not utilization.

2. The net effect of the present practice is to dewater the sludges on-site and then include the "amended soil" into the cover material. This is acceptable, provided, the "dewatering" is done in a drying bed. Drying beds, when properly constructed, are a surface impoundment subject to WAC 173-304-430.

3. Utilization will have to involve growing a crop. Applications being made to fallow ground, harvesting, or discing in a crop, etc.

The chemical toilet waste memo sent by you with a cutoff date of October 15, 1986, is not specifically required by either WDOE or Benton-Franklin Health Department. Chemical toilet waste was singled out because it is "raw sewage." Essentially all chemical toilet wastes are "mixed loads" of chemical toilet waste and septage. Even septage has a significant amount of "raw sewage" in it.

WDOE and Benton-Franklin Health Department view this material in the same light as raw sewage. As such, it should not be disposed to a landfill. In the absence of any immediately available, reasonable alternative, we would not ban the present practice until the 27th of May deadline. The generator, WDOE and this department are actively involved in finding an alternative for chemical toilet waste, i.e., a municipal sewage treatment plan. This may take several weeks or even months to resolve. In the interim, mixed loads of chemical toilet wastes and septage can be allowed.

A written response from you indicating agreement or exception to the points raised herein is in order.

Assuming we have agreement, we can proceed with the permit process.

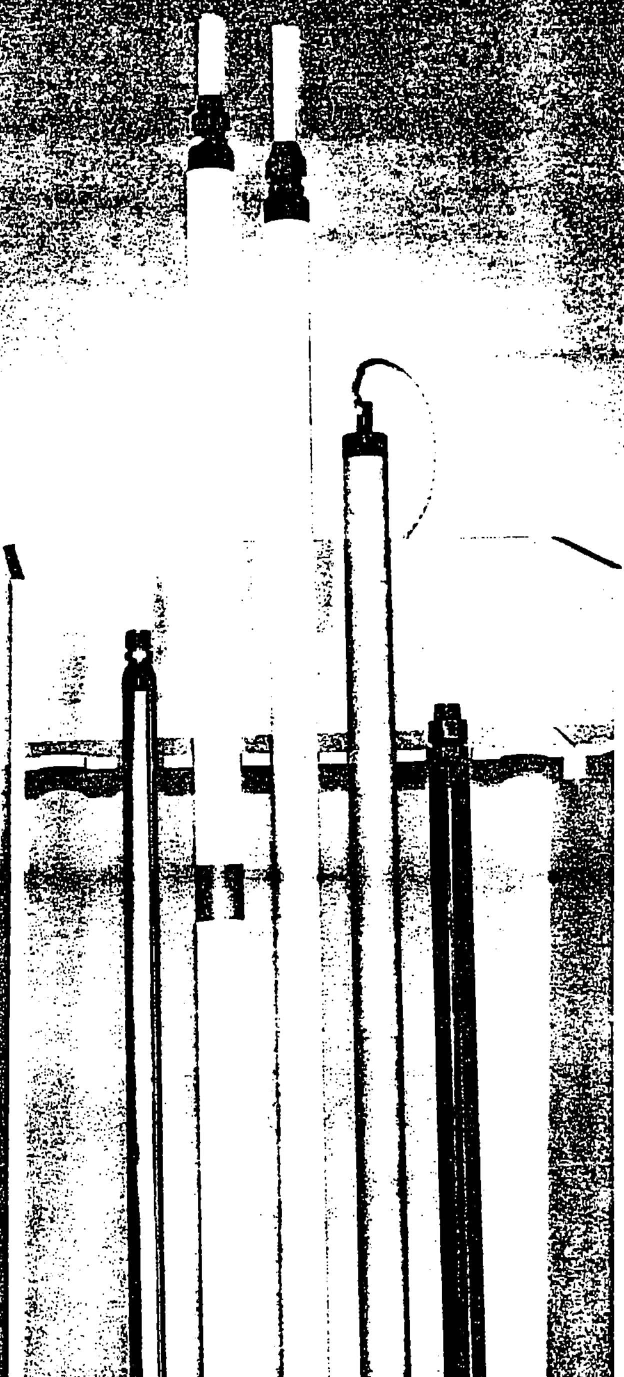
Sincerely,

Larry Kamberg

Lawrence D. Kamberg, R.S., Supervisor
Environmental Health Surveillance Section

cc: WDOE, Olympia
WDOE, Spokane

APPENDIX 3



GEOGUARD

Ground Water Sampling Systems

Ground water sampling involves a broad range of demands on sampling equipment. The varying objectives and variability of site conditions combine to require a range of sampling equipment that will meet a particular need.

The Geoguard line includes bailers, airlift pumps, bladder pumps and the exclusive Geoguard Two-Stage pump (patent pending). Most are available in models suitable for portable use as well as permanent installation.

With Geoguard's flexible systems approach, you can choose the right equipment for your specific sampling needs.

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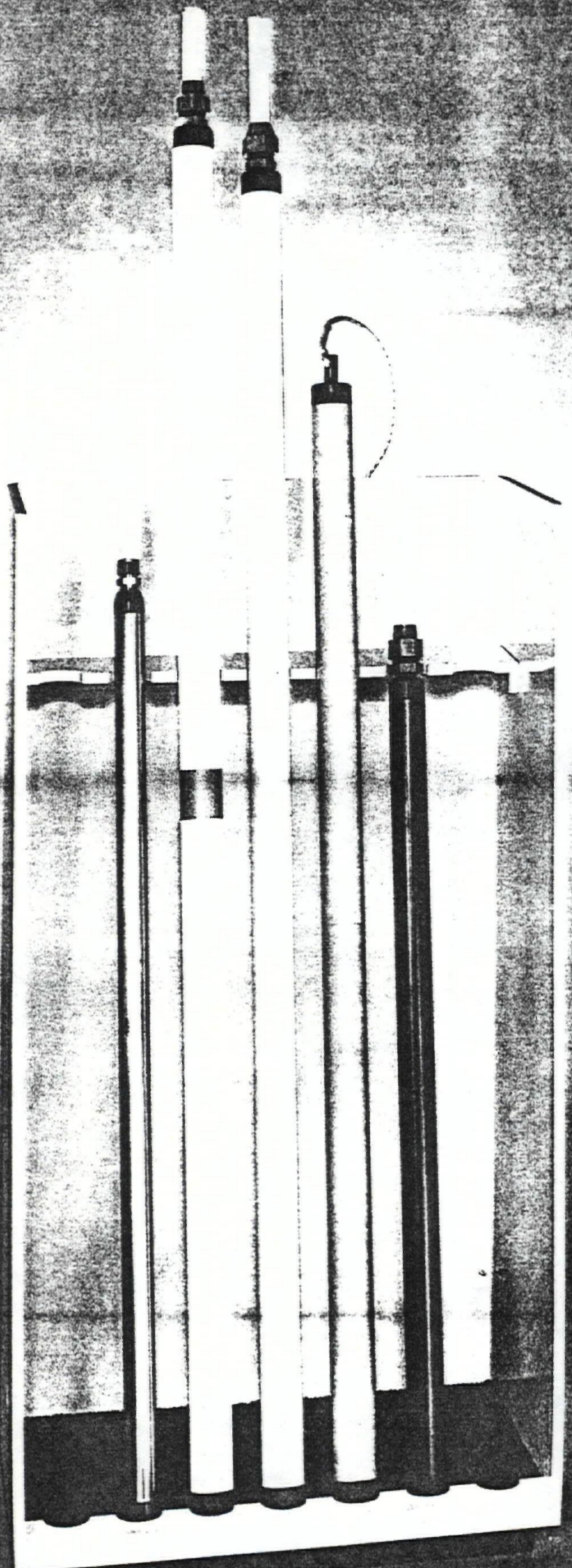
APPENDIX 3



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Geoguard Bailers

Geoguard bailers are designed for durability and efficient field use. A bailer can be the most cost effective means of sampling when wells are shallow and slow to recover or where site access is difficult.

Geoguard bailers feature;

- All PVC construction
- All connections are mechanical. No adhesives are used
- The bail and check valve assemblies are detachable for easy, thorough cleaning
- Geoguard bailers are beveled at the top and bottom to aid in lowering and retrieval and to reduce wear and splintering
- Can be taken apart in the middle to permit easier cleaning and storage
- All Geoguard bailers are equipped with a unique soft seat check valve to increase performance by minimizing back-flow from the bailer during retrieval
- Available in sizes for 1½" and larger wells

Geoguard Bladder Pumps

Geoguard bladder pumps offer innovative features to what is rapidly becoming the most desirable device for the collection of ground water samples destined for low level analysis.

Geoguard bladder pumps feature;

- Co-axial tubing to reduce the bulk associated with conventional twin tube designs. Co-axial tubing is tangle free and easier to clean in the field. Ideal for portable use
- Models available in all PVC construction, stainless steel/PVC and stainless steel/Teflon*
- Quick change bladder system for simple cleaning and replacement...bladders available in PVC or Teflon*
- O-ring seals for air-tight construction
- Outside diameter of 1⅜" permits use in 1½" wells
- Suitable for permanent installation or portable use

Teflon* is a registered trade-mark of E.I. DuPont de Nemours & Co.

Geoguard Airlift Pumps

Geoguard airlift pumps are designed to provide high flow rate with a minimum expenditure of compressed air. Geoguard airlifts offer a rapid means of removing large volumes of purge water prior to collecting a sample with a bailer or bladder pump.

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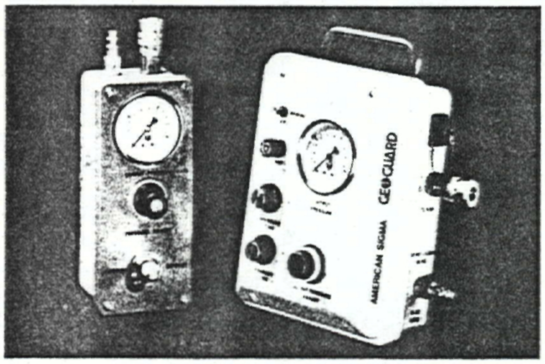
Manual & Automatic Controllers

Manual Controller: **Economical lightweight and compact. Recommended for use with extended length Airlift pump or Two-Stage pump.**
Automatic Controller: **Permits "hands-off" operation of Bladder pump, Airlift pump and Two-Stage pump.**

The Geoguard Controllers feature;

- Automatic and manual modes*
- Independent adjustment of discharge and intake functions*
- Compact and lightweight design
- Rugged water resistant structural foam case
- 12 VDC operation*
- Precise flow rate adjustment

*Automatic Controller only



Geoguard Product Specifications

Description	Model#	Outside Dia.	Inside Dia.	Overall Length	Capacity	Flow Rate	Material
Bailer	5300	1.90"	1.61"	58"	.48 Gal.	N/A	PVC
	5301	1.66"	1.38"	58"	.35 Gal.	N/A	PVC
	5302	1.32"	1.25"	58"	.30 Gal.	N/A	PVC
	5303	1.62"	1.49"	48"	.36 Gal.	N/A	S.S./TFE
	5304	1.38"	1.25"	48"	.25 Gal.	N/A	S.S./TFE
Airlift Pump	5305	1.90"	1.61"	62"*	.52 Gal.	2.5 GPM	PVC
	5306	1.66"	1.38"	62"*	.38 Gal.	2.0 GPM	PVC
	5307	3.50"	3.04"	48"	1.5 Gal.	7.0 GPM	PVC
	5308	1.62"	1.49"	62"	.45 Gal.	2.2 GPM	S.S./TFE
	5309	1.38"	1.25"	62"	.31 Gal.	1.7 GPM	S.S./TFE

Description	Model#	Outside Dia.	Inside Dia.	Overall Length	Capacity	Flow Rate	Material
Bladder Pump	5310 & 5312	1.38"	1.25"	38"	.1 Gal.	.75 GPM	S.S./PVC
	5311 & 5313	1.38"	1.25"	38"	.1 Gal.	.75 GPM	S.S./TFE
	5314	1.66"	1.25"	32"	.08 Gal.	.70 GPM	PVC
Two-Stage	5315	1.90"	1.61"	62"*	.36 Gal.	2.5 GPM	S.S./PVC
	5316	3.50"	3.04"	48"	1.34 Gal.	6.0 GPM	PVC

Notes: *Standard Length is 62 inches, may be increased by 33 inch increments for increased flow rate.

Performance of pneumatic pumps will vary with input pressure, lift and water level within the well. Data supplied is based upon 75 PSI input, 50 foot lift with 20 foot submergence.

AMERICAN SIGMA

One Elizabeth Street, P.O. Box 100, Middleport, NY 14105-0100
1-800-635-4567 (Toll Free) • 716-735-3616 (Within NY State) • Telex: 750101

SC 10667 1185 Q 5

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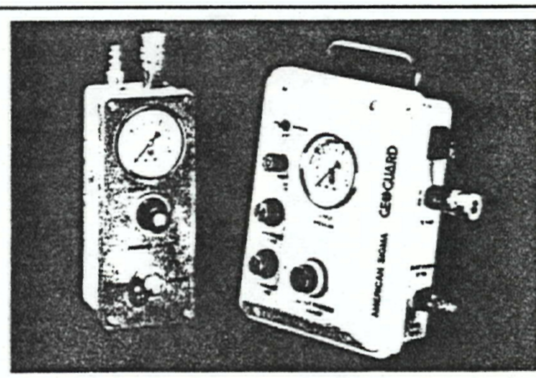

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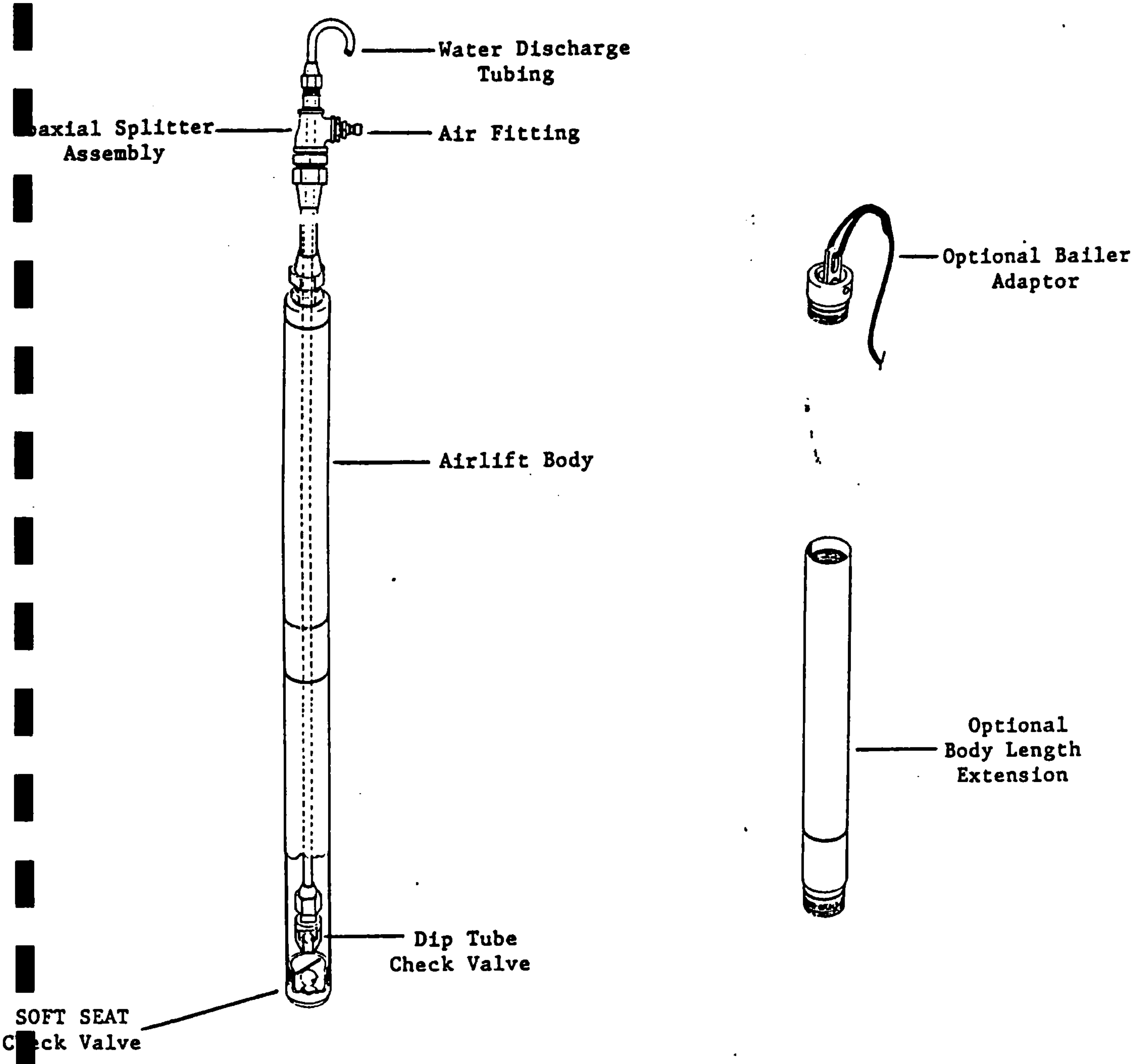
GEOGUARD
Airlift Pump

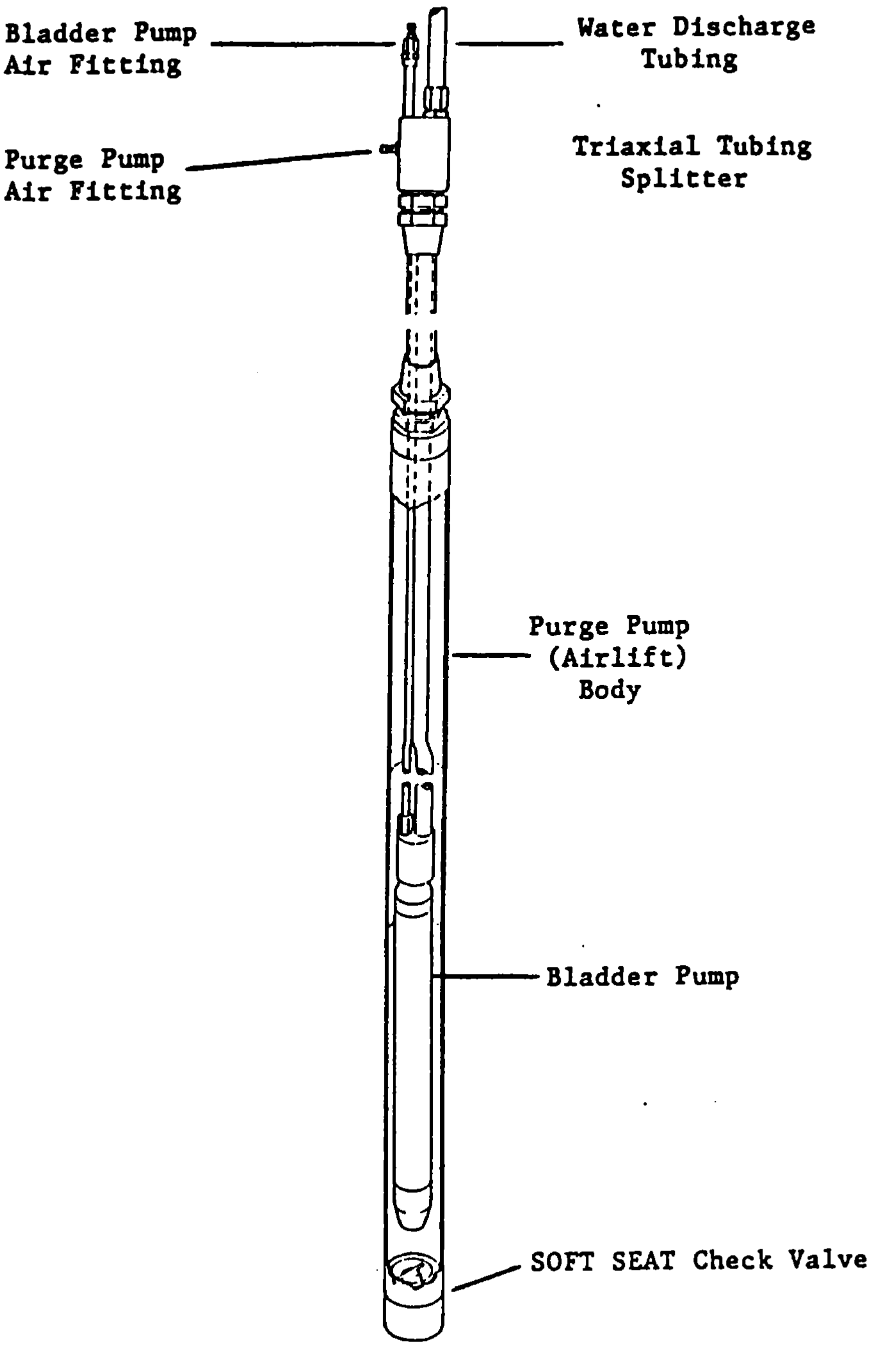


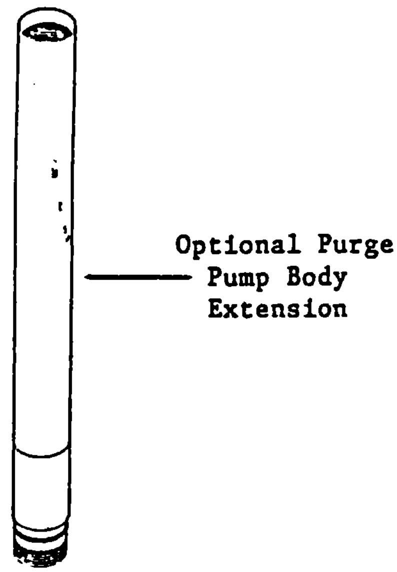
ONE ELIZABETH ST., P.O. BOX 300, MIDDLEPORT, N.Y. 14105-0300 (716) 735-3616

AMERICAN SIGMA

GEOGUARD

Two-Stage Pump





ONE ELIZABETH ST., P.O. BOX 300, MIDDLEPORT, N.Y. 14105-0300 [716] 735-3616

GEOGUARD

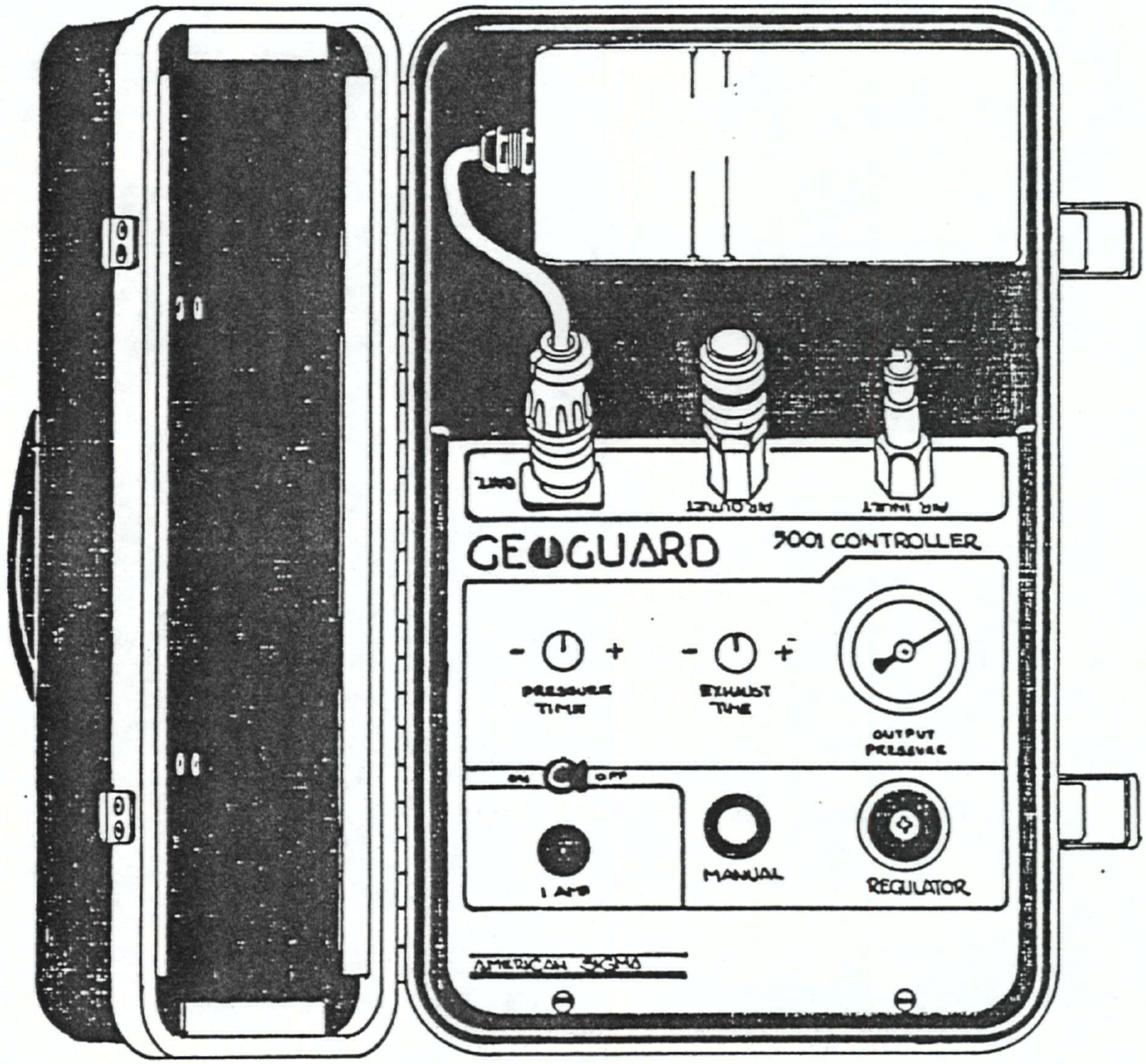
Automatic Cycle Controller Comparison

	5001	5000
Packaging	Fully self-contained. The battery, battery charger and the short air line fit inside the case. Molded polyethylene case with hinged top.	Controller, battery, charger and both air lines have to be carried separately. Structural foam case.
Dimensions	L 14-1/2" x W 9-1/4" x D 9-3/4"	L 9" x W 7" x D 4-1/4"
Weight	10 lb. w/battery, 5 lb. w/o battery.	14 lbs. w/battery, 9 lbs. w/o battery.
Power Consumption	4.6 Watts	6.4 Watts
Timer Range	4-27 sec. each	4-27 sec. each
Flow Control	Fully adjustable	Fully adjustable
Pressure Range	0-125 p.s.i	0-120 p.s.i.
Max. Input Pressure	150 p.s.i.	120 p.s.i.
Manual Override	Mechanical - controller will operate manually without battery.	Electrical - Controller can be operated manually but requires 12 VDC.
Overpressure Safeguard	150 p.s.i. pressure relief valve/blow-out plug	Blow-out plug
Air Flow Ability	CFM @ 80 psi: 44 100 psi: 45 120 psi: 46 150 psi: 48	CFM @ 80 psi: 35 100 psi: 39 120 psi: 41

AMERICAN SIGMA

GEOGUARD

Model 5001 Automatic Cycle Controller

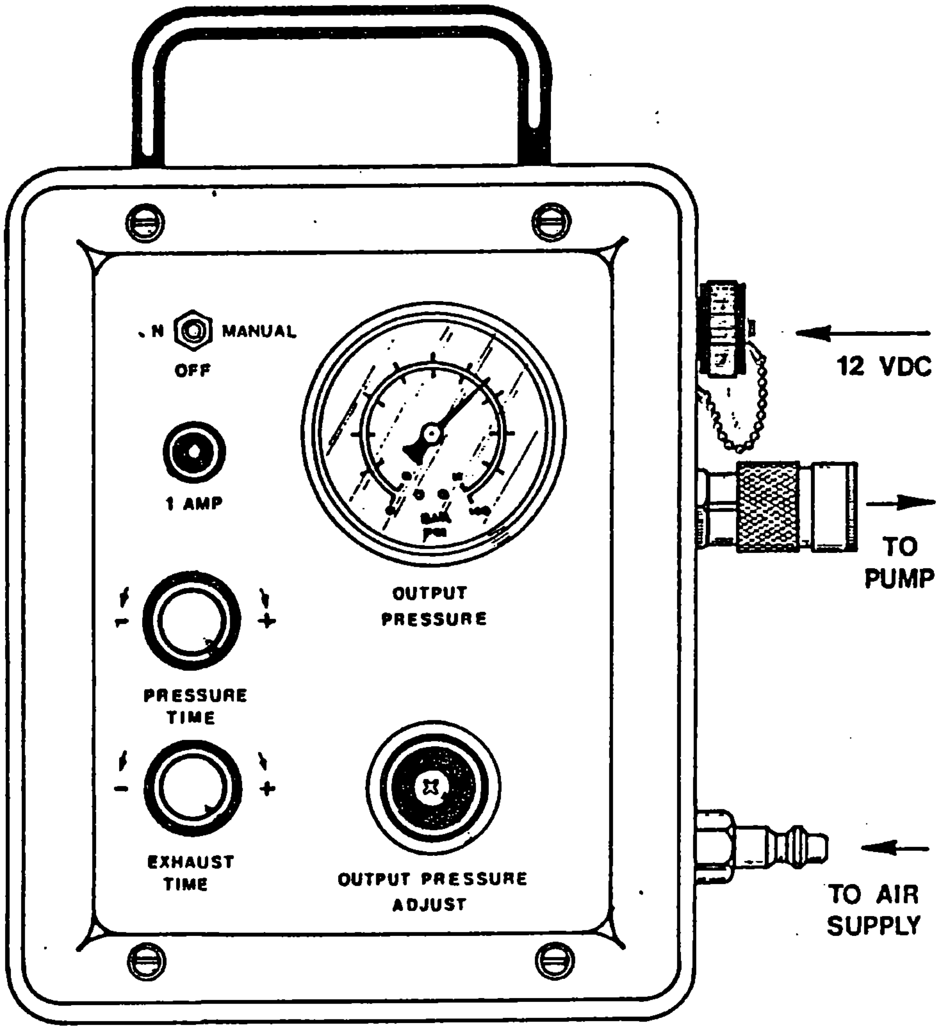


ONE ELIZABETH ST., P.O. BOX 300, MIDDLEPORT, N.Y. 14105-0300 (716) 735-3616

AMERICAN SIGMA

GEOGUARD

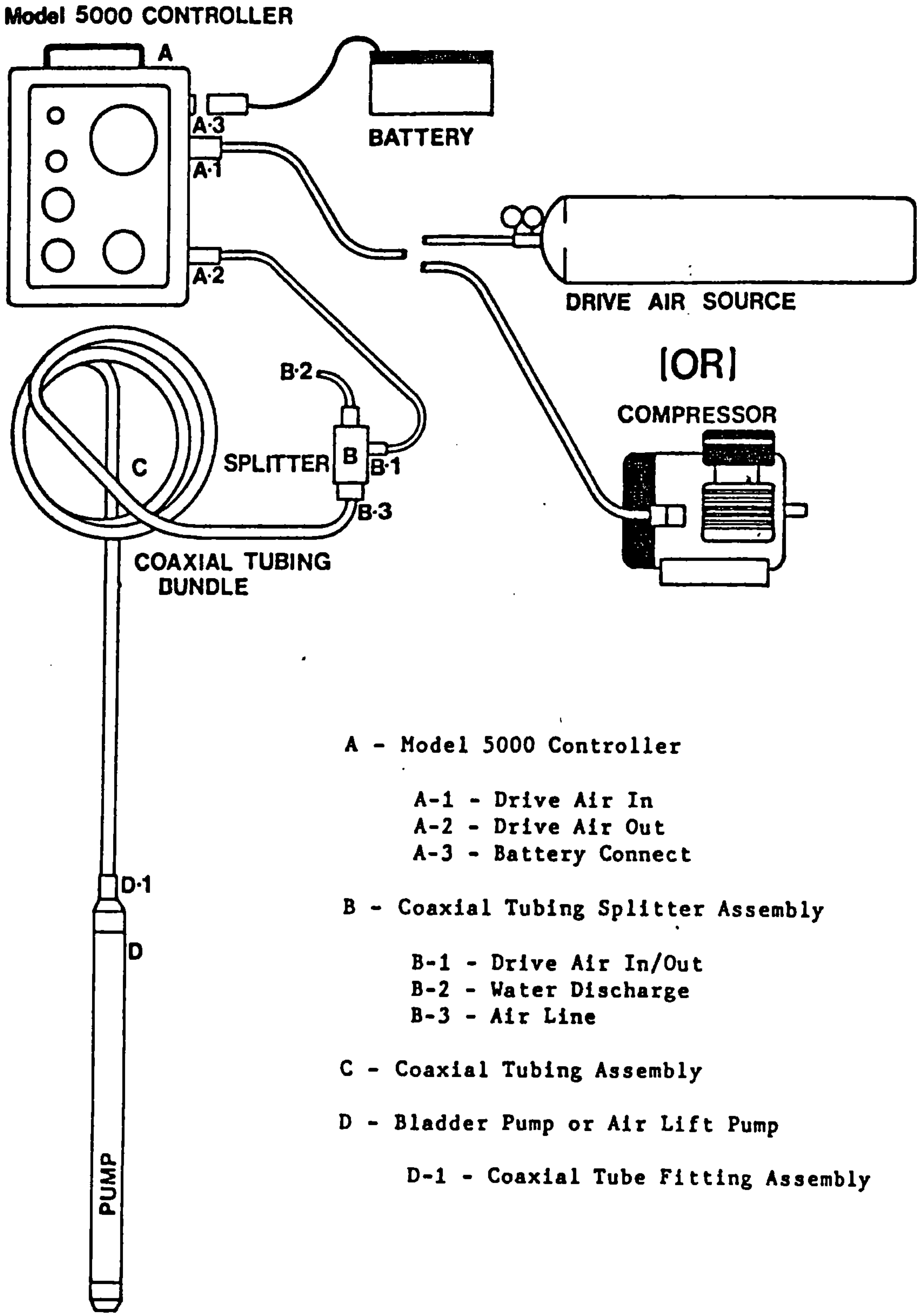
Model 5000 AUTOMATIC CONTROLLER



ONE ELIZABETH ST., P.O. BOX 300, MIDDLEPORT, N.Y. 14105-0300 (716) 735-3616

AMERICAN SIGMA

GEOGUARD Portable System Set-Up



A - Model 5000 Controller

- A-1 - Drive Air In
- A-2 - Drive Air Out
- A-3 - Battery Connect

B - Coaxial Tubing Splitter Assembly

- B-1 - Drive Air In/Out
- B-2 - Water Discharge
- B-3 - Air Line

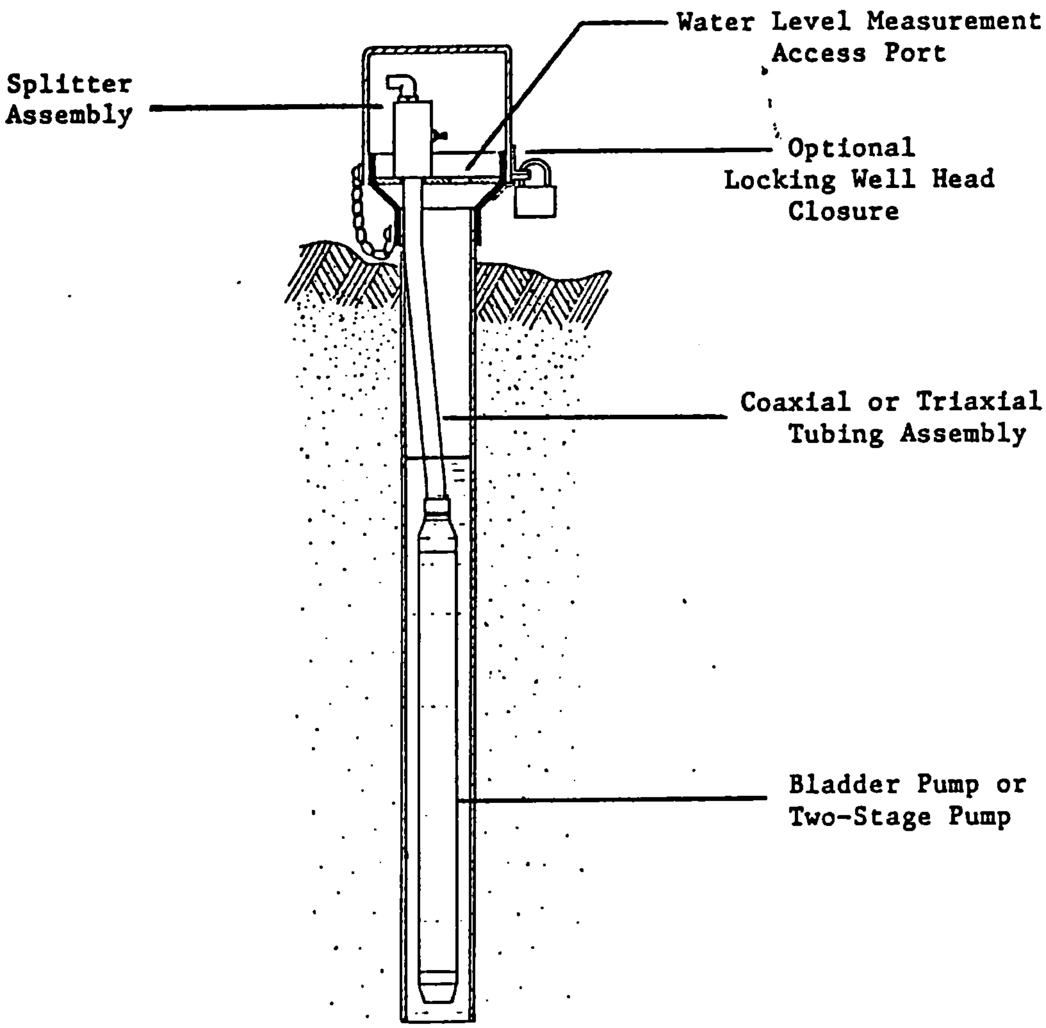
C - Coaxial Tubing Assembly

D - Bladder Pump or Air Lift Pump

- D-1 - Coaxial Tube Fitting Assembly

GEOGUARD

Dedicated System Components



GEOGUARD Information

Introduction

The expanding national focus on groundwater protection has created a broad new market for sampling equipment. AMERICAN SIGMA, in response to this new market is introducing a complete line of equipment aimed at groundwater sampling called GEOGUARD; the product line includes:

- Bailers
- Air Lift Pumps
- Bladder Pumps
- Two-Stage Pump
- Controllers
- Compressor Packages
- Field Compressor Cart
- Hose Reels
- Depth Measuring Devices
- Ancillary Equipment

Development of new equipment is on-going and additions will be introduced as they become available. Our current product inventory is designed to be very versatile and will address the majority of groundwater sampling equipment needs. Groundwater pumps are available for deep wells, shallow wells, small diameter (to 1-1/2") and large diameter. We offer down well components specifically designed and priced for permanent installation and models suitable for portable applications.

Market Potential

A wide variety of industry is expected to be required to monitor groundwater on a routine basis. It is difficult to estimate the number of industrial and manufacturing facilities that will be required to monitor and at the present time it appears that the emphasis on industry by regulatory agencies varies by state. However, the U.S.E.P.A. estimates that groundwater monitoring will be required at:

- 50,000 hazardous waste sites
- 45,000 solid waste landfills
- 40,000 mining sites
- 75,000 non-hazardous waste lagoons

To give an appreciation of the maturity of this market, only 1,246 landfills, impoundment ponds, waste lagoons and land treatment facilities are presently being required to monitor groundwater under federal statutes. This number does not represent those facilities which must monitor under state laws or many industries which have elected to establish monitoring programs for self protection and in anticipation of the inevitable legal requirement.

The legal framework supporting a groundwater equipment market consists of:

- Resource Conservation and Recovery Act of 1976
- Safe Drinking Water Act of 1974
- Clean Water Act of 1977
- Toxic Substance Control Act of 1976
- Surface Mining Control and Reclamation Act of 1977

Although the specific aims of these programs are largely directed at other broader environmental concerns, they all indirectly impact on groundwater problems. Basically, these laws state that the particular surface activity regulated by one or more of these statutes must not harm the groundwater. In most cases the only way to determine this is to install groundwater monitoring systems and initiate a routine monitoring program.

Groundwater monitoring is generally accomplished by installing a series of monitoring wells at a facility (landfill, industrial plant, etc.). Samples are withdrawn from these wells and are analyzed for water quality. One set of samples will indicate the quality of the groundwater at the time of collection but they will not indicate whether the groundwater is being degraded by the activities at the surface. Therefore, samples are collected and analyzed from the same wells at regular intervals. By comparing the results of current samples with previously collected samples, one can determine whether or not the surface activity is affecting the aquifer. It is this aspect of the Federal Environmental Laws cited previously that has created a market for sampling equipment.

Groundwater Sampling

Groundwater sampling protocols tend to vary widely from state to state, however, some basic considerations are common to virtually all groundwater sampling programs.

In general, all groundwater sampling protocols require that several "standing volumes" of water be removed from the monitoring well and discarded prior to sampling. This is due to the period of time between sampling events. As much as three to six months will elapse between sampling events. The water standing in the open well casing will become stagnant and may change in chemical composition due to exposure to atmospheric air and pressure. To insure that the sample is representative of the aquifer, this stagnant water must be removed from the well. Usually three to five standing well volumes are removed prior to sampling.

The process of removing the stagnant water from the well is called purging. Quite often purge volumes will exceed twenty gallons per well depending upon the well diameter, depth and standing water level. Following the purging activity, the well is usually allowed to fully recover whereupon a sample is withdrawn for analysis. Sample volumes will vary depending upon the number and type of parameters to be measured. Generally, sample volumes will not exceed two gallons for the most thorough examinations.

Laboratory analytical capabilities have improved dramatically over the past decade. It is not uncommon to report anyalytical results in the parts per billion range and even parts per trillion are possible for some organic parameters. Anaylsis to this detection level is very expensive, for example, the cost to analyze one sample for priority pollutants will cost between $800.00 and $1,200.00.

Ironically, sample acquisition technology has not kept pace with advances made in the laboratory. Samples are still collected (in many cases) with fifty year old methods and delivered for analysis to a multimillion dollar state-of-the-art laboratory. Even the most elaborate laboratory cannot correct a poorly collected sample.

With detection levels at the parts per billion range, small changes in water chemistry caused during the sampling effort can be seen. Since monitoring programs are designed to pick-up trends in water quality, it is extremely important that anything possible be done in the field to reduce the potential for doubt as to sample representativeness as sampling forms the basis for the ultimate accuracy of the analytical effort.

Some major factors which may impact sample representativeness:

1. Sampling Equipment (lift mechanism)
2. Sampler Materials
3. Consistency of Method
4. Cross Contamination

1. Sampling Equipment (lift mechanism)

Recent studies of the effects of lift mechanisms on sample representativeness indicate that the way in which the sample water is lifted from the well is important. A good lift mechanism will not aerate the sample. Aeration can cause irregular changes in the sample. For example, many organic compounds are readily oxidized when exposed to dissolved oxygen, bubbling air in the well or introducing air to the sample during lifting can change the chemistry of the sample. Some organic parameters are volatile and may be stripped from the sample if air is bubbled through it. Dissolved gases such as CO_2 may be stripped from the sample, changing sample pH and possibly altering the state of some parameters - metals which may be in solution at a low pH could precipitate out of solution due to an increase in pH.

Applying suction to lift the sample may produce similar effects by causing outgasing of CO_2 and volatile organics.

Solids may pose a problem due to lift mechanism. Metals analysis is generally aimed at dissolved metals. If the lift mechanism creates shock waves in the well or applies a vigorous suction at the submerged intake of the sampling pump, solids may be encouraged to migrate into the well. This means that the sample aliquot destined for metals analysis will have to be filtered prior to analysis which is time consuming, increases analytical costs and exposes the sample to extraordinary conditions which can render it unrepresentative of the source.

2. Sampler Materials

Proper selection of sampler material is important. It is known for example that the oxidized outer surface of stainless steel can affect some organic parameters. Adsorption to or disorption from the sampling system may also introduce change to the sample water during collection. Some metals, such as mercury, may plate out on glass or metals. Many plastics can introduce contaminants to the sample. Phthalate esters, commonly used as plasticizers in flexible and semi-rigid plastic tubing can be troublesome. Not only are these compounds on the priority pollutant list but even if they are not a parameter of interest, they can mask other parameters (PCBs for example) that are under investigation.

Many states have initiated sampling verification programs which require resampling and analysis if the latest analytical results vary more than 10% from the previous sampling effort. This can be a very costly penalty for a poor material choice.

3. Consistency of Method

One effective means of reducing the variability of sample results is to standardize the sampling method. Since monitoring programs are usually designed to assess trends in groundwater quality it is very important that all wells at any given facility be treated exactly the same way each time they are sampled. Regulatory personnel readily acknowledge the fact that a ten year data base of national groundwater quality is virtually useless due to the extreme variable means used to generate the samples.

If one were to sample a well the first time with a bailer, the next time with a suction pump, the third time with a bladder pump and the fourth time with an electric submersible pump, the potential for sample variations is much greater than if all four events had been sampled with the same type of lift mechanism. This variability in sampling method is very common when a facility contracts to have the wells sampled by competitive bid each year. It is quite possible in this case to have as many as five different methods employed for sample aquisition over a five year period making accurate trend analysis suspect at best.

4. Cross Contamination

Cross contamination may result from using the same sampling device to sample a series of wells. If one well on the facility is contaminated and the sampler is not thoroughly cleaned between wells, contaminants from one well may be dragged to one or more of the other wells making contamination assessment very costly and difficult.

Another type of well contamination can occur due to the nature of the environment in which the sampling is being carried out. Windborn dust at landfills is virtually impossible to eliminate as a potential contaminant. An example of the problem is bailing wells on a windy day. Each time the bailer is withdrawn from the well, the wet outer surface is exposed to wind born dust. When the bailer is again lowered into the well the dust which has attached to the bailer is rinsed off by the well water. It may be necessary to lower and retrieve the bailer over 100 times to purge one well making the potential for sample contamination very high.

AMERICAN SIGMA's GEOGUARD Groundwater Sampling Equipment

A full line of groundwater sampling equipment must address the following:

1. Extreme Variability of Site Specific Conditions
2. Performance
3. Sampling Integrity
4. Variable Sampling Objectives
5. Variability of Well Sizes
6. Variability of Well Depths
7. Competitive Pricing
8. Simplicity of Use
9. Durability

The GEOGUARD line consists of a variety of down well components:

1. Bailers
2. Airlift Pumps
3. Bladder Pumps
4. Two-Stage Pumps

With the exception of the two-stage pump, other companies offer one or the other of the remaining devices. Timco offers the broadest range of products by offering bailers, airlift and bellows pumps. The GEOGUARD series offers advantages over other designs which makes it a credible new entry into the goundwater sampling market. For example, GEOGUARD bailers are designed for rigorous field use by the use of tapered check valve body and basic assembly.
Both are removable for thorough cleaning.

Also, the soft seat check valve reduces the possibility of leakage during withdrawl from the well.

GEOGUARD Air Lift Pumps utilize a coaxial tubing configuration which is much easier to use in the field as it eliminates tangling of the air and water lines found on conventional designs. GEOGUARD airlifters are also equipped with the soft seat check valves to prevent air from burping through the check valve into the water column. It also improves performance by preventing water contained within the air lift body from escaping through the bottom check valve during the pressure cycle.

GEOGUARD Bladder Pumps feature the coaxial tubing configuration, portable and dedicated units, sizes to accomodate wells down to 1-1/2" I.D. and are fully field serviceable.

The most unique product in the GEOGUARD line is the two-stage pump. This device combines the flow rate advantages of an air-lift pump with the sampling integrity of the bladder pump. Designed to be dedicated, they are available with or without screened intakes to provide a remedial fix to wells with broken or improper sized well screens. The air-lift stage is capable of being lengthened by 33" increments to produce an extremely efficient means of purging large volumes of water from a well prior to sample collection. The collection of the sample utilizes a bladder pump which is contained within the air-lift body. This combination is unique to the groundwater sampling market and AMERICAN SIGMA is applying for a patent on the device.

All dedicated equipment, which at present, includes the bladder pump, air-lift pump and the two-stage pump are delivered clean and fully assembled (including tubing), ready for immediate installation.

Controller

AMERICAN SIGMA GEOGUARD controller is very compact and lightweight. Due to the necessity of cycling the pumps (vent/pressure) the controller is equipped with independent adjustment of both halves of the cycle. The time range for each pot is 1-25 seconds. This range is supplied on the standard unit - other ranges are available if the application warrants it.

The controller is also equipped with a built-in pressure regulator which is useful for adjusting flow rate at the well site for optimizing air consumption/flow rate or for collecting sensitive parameters such as volatile organics. Although the top of the line controller is automatic, it also features a manual mode which is useful when using with the extended length air-lift or the extended length two-stage.

Air-Lift Operation and Application

The air-lift (or gas-lift) pump is the simplist of the GEOGUARD pumps. As seen in the drawing, the air-lift pump has a cylindrical body with check valve at the bottom. The check valve allows water to enter the air-lift body and prevents water from escaping out the bottom. The top of the air-lift body is fitted with a removable cap which is tapped to accept a compression fitting. Two lengths of tubing, coaxially arranged, extend from the top of the well to the air-lifter. The outer length of tubing terminates at the compression fitting. The inside length of tubing extends through the compression fitting to approximately two inches above the bottom of the air-lift body.

The outer length of tubing conduits air from the ground surface to the air-lift body. The inner length of tubing conduits water from within the air-lift body to the ground surface.

The air-lift pump is actuated by applying compressed air to the outer length of tubing. This compressed air applies pressure to the surface of the water within the air-lift body. This action causes water to exit the air-lift body via the inner tubing extending to the bottom of the air-lift body, to the ground surface. After the body is evacuated, pressure is released to the atmosphere which allows the check valve to open and the pump refills. Once the body refills, the process is repeated.

Airlifters have fallen into disfavor for sample collection due to the direct air/water contact. However, it is a very rapid and effective means of removing large volumes of water from wells. Since most of the water which is removed from monitoring wells during sampling is discarded (purge water), the air-lifter is still a useful tool for groundwater sampling if used only for the purge activity prior to sampling with a more appropriate device (bailer, bladder pump).

Bladder Pump Operation and Application

The bladder pump has essentially evolved from the air-lift pump in that the bladder pump has a cylindrical outer body, bottom check valve and a very similar tubing arrangement. The bladder pump differs primarily by the addition of a bladder within the pump body. The bladder acts as a barrier between the air and water. In order to prevent water in the discharge tubing from re-entering the bladder during the vent side of the cycle, an additional check valve is installed in the top assembly of the pump body.

When the bladder pump is vented to atmosphere, water enters the bladder through the bottom check valve. When compressed air is delivered to the pump, the bladder is squeezed causing the bottom check valve to close and the water to be forced up through the upper check valve to the ground level.

After the bladder is fully evacuated, the pump is vented back to atmosphere, which causes the upper check valve to close preventing water from falling back into the bladder from the water discharge tubing. The bottom check valve opens due to the pressure head over the pump being greater than the pressure inside the pump, allowing the bladder to refill through the bottom check valve. Continuous operation of this pump relies upon the alternating pressure/vent cycles.

The bladder pump is highly regarded as a sampling device due to no air/water contact and it performs adequately as a purge pump except for flow rate.

Flow rate and air consumption are poor in that each time a 350 ml of water is purged, the entire air line must be brought to lift pressure, this consumes air. The lift pressure must be vented to atmosphere each time 350 ml of water is ejected which consumes time.

Two-Stage Pump

The two-stage pump combines the high flow rate characteristics of the air-lift pump with the sampling benefits associated with the bladder pump. Essentially, the two-stage pump is an air-lift pump with a bladder pump contained within it. In operation, the air-lift pump is actuated for purging the well, the bladder pump acts as the air-lift "dip tube" during the purge mode. Since the purge water is discarded, air/water contact for this activity is not a problem. Once the well has been adequately purged, the bladder pump is actuated for lifting the sample to the surface without air/water contact.

The soft seat check valve in the air-lift (1st stage) pump prevents air from "burping" through the valve into the water column which would aerate the well water.

The GEOGUARD Two-Stage Pump incorporated into a dedicated system will literally pay for itself in 2-5 years by reducing the number of people required to carry out the sampling as well as cutting field time by as much as 500% over bailing.

APPENDIX 4

ALCHEM LABORATORY

250 S. Beechwood Avenue, Suite II
Boise, Idaho 83709
(208) 376-2257

LABORATORY REPORT

RECEIVED
KENNEWICK, WASH

MASCO PRODUCTS
P.O. BOX 2518
YAKIMA , WA 98907

ATTENTION: JIM MILLER
SOURCE -: U 1

DATE COLLECTED - - -: 08/26/86
TIME COLLECTED - - -: 8:02 AM
DATE RECEIVED - - - : 08/28/86
DATE REPORTED - - - : 09/24/86
SUBMITTED : JIM MILLER

LAB SAMPLE NUMBER - 1399

BACTERIA (Organisms/100ml)

TOTAL COLIFORM		FECAL STREP	
FECAL COLIFORM		STD PLATE COUNT	

WET CHEMISTRY (mg/l unless noted)

BIOCHEMICAL OXYGEN		FLUORIDE	
CHEMICAL OXYGEN DEMAND		HARDNESS	
OIL & GREASE			
SUSPENDED SOLIDS		AMMONIA	
TOTAL DISS. SOLIDS		AMMONIA DIST.	
TOTAL SOLIDS		NITRATE	
VOLATILE SOLIDS		NITRITE	
SETTLEABLE SOLIDS		ORGANIC NITROGEN	
		TOTAL KJELDAHL NITROGEN	
ACIDITY			
ALKALINITY		PHENOL	
BICARBONATE		pH (S.U.)	
CARBONATE		ORTHO PHOSPHATE	
CALCIUM		TOTAL PHOSPHATE	
CHLORIDE		SULFATE	
RESIDUAL CHLORINE		SULFIDE	
COLOR		SURFACTANT	
SPEC. CONDUCTANCE		TANNIN & LIGNIN	
CORROSIVITY		TEMPERATURE	
CYANIDE FREE		T.O.C.	
CYANIDE TOTAL	(0.005	TURBIDITY (N.T.U.)	
CYANIDE WEAK ACID DIS		E P TOXICITY	

ADDITIONAL TESTS AVAILABLE UPON REQUEST

METALS (mg/l) unless noted

ALUMINUM	
ANTIMONY	
ARSENIC	
BARIUM	
BORON	
CADMIUM	
CADMIUM GRAPHITE	(0.001
CHROMIUM	
CHROMIUM GRAPHITE	0.004
CHROMIUM, HEXAVALENT	(0.005
COBALT	
COPPER	
GOLD	
IRON	
LEAD	
LEAD GRAPHITE	
MAGNESIUM	
MANGANESE	
MERCURY	
MOLYBDENUM	
NICKEL	(0.01
POTASSIUM	
SELENIUM	
SILICON	
SILVER	
SODIUM	
TIN	
TITANIUM	
ZINC	0.030

Laboratory supervisor

**** CD GRAPH ****

CADMIUM_GRAPHITE

CHEMIST S Powell

DATE 9/14/86

	RESULTS (CONC.)
Q.C.	.0023, .0021, .0021
SAMPLE NO.	
1385	<001
1387	<001
1399	<001
1400	<001
1401	<001
1402	<001
1403	<001
1404	<001
1436	<001
1512	<001
1555	<001
1561	<001
1591	<001

Masco

Q.C. WS378 (EPA) Conc. 3

Limits = .0013 - .0026

Actual Value = .0020

.0023

.0021

.0021

**** CR GRAPH ****

CHROMIUM, GRAPHITE

CHEMIST [signature]

DATE 9/18/86

RESULTS (CONC.)	
Q.C.	
SAMPLE NO.	
1385	<01
1387	<01
1399	.004
1400	.002
1401	<001
1402	.001
1403	.0025
[illegible]04	.0025
1512	
1555	
1561	
1591	

MASCO

EPA Q.C. WS378 #14

Limits .040 – .056

Actual → Value = .048

.052
.048
.054
.054
.042

Average 0.05

State Proficiency

#1

.0504 – .0696

Value = .060

.052
.068
Ave. .06
.059
.062

.060

#2

.128 – .[illegible]

Value = .[illegible]

.155
.155
.15[illegible]

.15[illegible]

Laucks Testing Laboratories, Inc.

Certificate

940 South Harney St. Seattle, Washington 98108 (206)767-5060

Chemistry, Microbiology, and Technical Services

CLIENT: JUB Engineers
PO Box 424
Pasco, WA 99301
ATTN: Larry Dietrich

LABORATORY NO: 99580

DATE: Nov. 10, 1986

JOB# 12322

REPORT ON: WATER

SAMPLE IDENTIFICATION: Submitted 10/29/86 and identified as shown below:

1) EE2 10/23 4:30 Zillich/Dietrich
2) EE3 10/24 2:20 Zillich/Dietrich
3) JUB 2T 10/23 10:30 Zillich/Dietrich
4) JUB Control 10/26 9:27

TESTS PERFORMED AND RESULTS:

Samples were analyzed for priority pollutants in accordance with Test Methods for Evaluating Solid Waste (SW-846), U.S.E.P.A., 1982, Method 8240 (volatile organics), selected compounds only.

Volatile Organics (by GC/MS)

	parts per billion (ug/L)				
	1	2	3	4	Lab Blank
1,1-Dichloroethylene	6.	170.	9.	L/1.	L/1.
1,1-Dichloroethane	13.	470.	40.	L/1.	L/1.
trans-1,2-Dichloroethylene	10.	330.	20.	L/1.	L/1.
Chloroform	trace	66.	18.	L/1.	L/1.
1,1,1-Trichloroethane	60.	2400.	150.	L/1.	L/1.
Trichloroethylene	46.	2400.	150.	L/1.	L/1.
Tetrachloroethylene	22.	110.	7.	L/1.	L/1.
Toluene	L/1.	1700.	L/1.	L/1.	L/1.
*Total Xylenes	L/1.	590.	L/1.	L/1.	L/1.

Laucks Testing Laboratories, Inc.

940 South Harney St., Seattle, Washington 98108 (206)767-5060

Certificate

Chemistry, Microbiology, and Technical Services

JUB Engineers

LABORATORY NO: 99580

Key

* = additional compounds from the EPA's Hazardous Substances List
L/ = "less than"
trace = an unquantifiable amount between 1-5 parts per billion.

Respectfully submitted,

Laucks Testing Laboratories, Inc.

J. M. Owens

J. M. Owens

JMO:dr

Laucks
Testing Laboratories, Inc.
940 South Harney St. Seattle, Washington 98108 (206)767-5060
Chemistry, Microbiology, and Technical Services

Certificate

JUB Engineers

LABORATORY NO: 99580

APPENDIX

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of organic compounds. The surrogates are added to every sample prior to extraction and analysis to monitor for matrix effects, purging efficiency, and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

Sample No.	Surrogate Compound	Spike Level	Spike Found	% Recovery	Control Limit
		parts per billion (ug/L)			
Lab Blank	d4-1,2-Dichloroethane	50.0	48.0	96.0	77-120
	d8-Toluene	50.0	50.5	101.	86-119
	p-Bromofluorobenzene	50.0	49.9	99.8	85-121
1	d4-1,2-Dichloroethane	50.0	44.6	89.2	77-120
	d8-Toluene	50.0	51.2	102.	86-119
	p-Bromofluorobenzene	50.0	53.3	107.	85-121
2 re-inject	d4-1,2-Dichloroethane	50.0	48.5	97.0	77-120
	d8-Toluene	50.0	49.1	98.2	86-119
	p-Bromofluorobenzene	50.0	49.3	98.6	85-121
3	d4-1,2-Dichloroethane	50.0	43.7	87.4	77-120
	d8-Toluene	50.0	49.7	99.4	86-119
	p-Bromofluorobenzene	50.0	52.4	105.	85-121
4	d4-1,2-Dichloroethane	50.0	46.5	93.0	77-120
	d8-Toluene	50.0	49.1	98.2	86-119
	p-Bromofluorobenzene	50.0	47.9	95.8	85-121
2	d4-1,2-Dichloroethane	50.0	49.1	98.2	77-120
	d8-Toluene	50.0	45.8	91.6	86-119
	p-Bromofluorobenzene	50.0	47.4	94.8	85-121

APPENDIX 5

FIELD SP PASCO 10/86

	A	B	C	D
1		FIELD SPIKE DATA SHEET		
2	DATE 10/68			
3	SITE PASCO			
4		CHROMIUM	LEAD	MANGANESE
5	JUB CONTROL	0.005	.005	.010
6	SPIKE (MG/ML)	0.200	.200	.400
7	SPIKE (ML)	1.000	1.000	1.000
8	MG ADDED	0.200	.200	.400
9	SAMPLE VOL. (ML)	870.000	870.000	870.000
10	THEORETICAL CONC. (MG/L)	0.235	.235	.469
11	MEASURED CONC. (MG/L)	0.189	.075	.350
12	% RECOVERY	80.557	31.967	74.590
13				
14				
15	EE3	0.005	.005	1.390
16	SPIKE (MG/ML)	0.200	.200	..400
17	SPIKE (ML)	1.000	1.000	1.000
18	MG ADDED	0.200	.200	.400
19	SAMPLE VOL. (ML)	830.000	830.000	830.000
20	THEORETICAL CONC. (MG/L)	0.246	.246	1.870
21	MEASURED CONC. (MG/L)	0.208	.100	1.730
22	% RECOVERY	84.667	40.705	92.529

APPENDIX 6

APPENDIX 6
ANALYTICAL METHODS

Primary Chemical and Physical Contaminants	Analytical Method	Reference
Arsenic	206.2-1	EPA 600
Barium	208.1-1	EPA 600
Cadmium	213.1-1	EPA 600
Chrome	218.2-1	EPA 600
Fluoride	340.2-1	EPA 600
Lead	239.2-1	EPA 600
Mercury	245.1-1	EPA 600
Nitrate (as N)	353.3-1	EPA 600
Selenium	270.2-1	EPA 600
Sodium	273.1-1	EPA 600
Silver	272.1-1	EPA 600
Turbidity	180.1	EPA 600
Primary Drinking Water Pesticides		
Endrin	8080	SW 846
Lindane	8080	SW 846
Methoxychlor	8080	SW 846
Toxaphene	8080	SW 846
2,4-D	8050	SW 846
2,4,5-TP Silvex	8050	SW 846
Secondary Chemical and Physical Contaminants		
Chloride	325.3	EPA 600
Color	110.1	EPA 600
Copper	220.1	EPA 600
Iron	236.1	EPA 600
Manganese	243.1	EPA 600
Specific Conductivity	120.1-1	EPA 600
Sulfate	375.3	EPA 600
Total Dissolved Solids	160.1-1	EPA 600
Zinc	259.1	EPA 600

Minimum Functional Standard Contaminants

Temperature	170.1	EPA 600
Conductivity	120.1	EPA 600
pH	150.1-1	EPA 600
Chloride	325.3	EPA 600
Nitrate	350.3	EPA 600
Nitrite	354.1	EPA 600
Ammonia	350.3	EPA 600
Sulfate	375.3	EPA 600
Dissolved Iron	235.1-01046	EPA 600
Dissolved Zinc	289.1-01090	EPA 600
Dissolved Manganese	243.2-01056	EPA 600
Chemical Oxygen Demand	410.1-1	EPA 600
Total Organic Carbon	415.2	EPA 600
Total Coliform	909a	STD METHODS

Organic Solvents

1,1-Dichloroethylene	8240	SW 846
1,1-Dichloroethane	8240	SW 846
Trichloroethylene	8240	SW 846
Chloroform	8240	SW 846
1,1,1-Trichloroethane	8240	SW 846
Trichloroethylene	8240	SW 846
Tetrachloroethylene	8240	SW 846
Toluene	8240	SW 846
Total Xylene	8240	SW 846